American
Gas Journal
THE MAGAZINE OF GAS DISTRIBUTION

SEPTEMBER 1960

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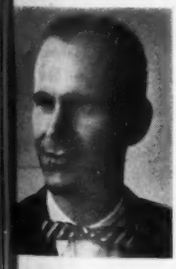
PILOT.. ..LIGHTS

Welcome Aboard . . .

. . and meet two new members of the AGJ editorial group. Joining the ranks as consulting editors this month are Joseph A. Kornfeld, natural gas consultant, and Carol L. Neaves, distribution engineer for a major gas utility.

Joe Kornfeld is no stranger to AGJ's readers. Those who've been following his informative series on "Aquifers for Underground Storage of Natural Gas" are familiar with his thorough work. As consulting editor for AGJ, he will keep readers informed on what's new in gas storage and other important developments in gas supply and economics of interest to gas distribution men.

Author of the book, *Natural Gas Economics*, and an industry lecturer on gas storage, methane liquefaction, and economics at the University of Texas School of Gas Technology, Kornfeld has been active in the natural gas field since 1944.



Carol Neaves, our new consulting editor in the fields of distribution, engineering, construction, maintenance, and operations, is not only a top-flight engineer, but also an outstanding civic leader in his community. Neaves, distribution engineer for the Dallas Division of Distribution, Lone Star Gas Company, has a varied and extensive 13-year career in gas distribution, covering all phases of design, construction, and maintenance.

Active in civic and industry groups, Neaves has served as president of the Dallas Junior Chamber of Commerce and was selected as "outstanding state director" of the Texas Jaycees in 1954. He is also active in the Southern Gas Association, National Association of Corrosion Engineers, American Right-of-Way Association, and is a registered professional engineer.

Contributions of these two outstanding gas men will be reflected in coming months in articles of special interest to our readers.

American Gas Journal

ONLY MAGAZINE EDITED EXCLUSIVELY FOR THE GAS DISTRIBUTION INDUSTRY

Volume 187 September 1960 Number 10

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Naugatuck KRALASTIC

The Original ABS Resin

Huge 40-foot length of KRALASTIC pipe is easily carried by one man in Orange County, Cal., during installation of 4-mile pipeline, by Pacific Pipeline Construction Co., Montebello, Cal.

Replaces Metal Pipe for Good

A new 4-mile KRALASTIC® pipeline, being used by Orange County, Cal., to carry natural and sewer gas, not only ends the need for yearly replacement, but made replacement of the original metal pipe far easier than expected.

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M C F

NEWS HILITES OF THE INDUSTRY

The consumers' "protector," former FPCommissioner William R. Connole, might return to the Federal Power Commission as chairman if the Democrat party regains the presidency this election year, according to Washington sources. A majority on the commission — three members — can be named by the new president . . . one vacancy now exists, there is one interim appointment, and one term (Arthur Kline) expires next June.

King-size transistorized computers are being added by two major companies. Brooklyn Union Gas Company will install an IBM 7070 system to streamline its accounting procedures, improve customer service, and aid in areas such as control of material inventory. Arizona Public Service will install its second large scale computer, a Remington-Rand Univac Solid State 80, as a companion to a Univac now in operation. The new transistorized computer, while smaller in size, has greater capacity, and will be used to solve complex engineering problems.

How safe is "flameless"? New $6,000,000 advertising campaign underway by Edison Electric Institute is promoting the idea that only electric heating and electric appliances are "safe" . . . because they are flameless. Copy in the EEI ads notes that is "the safe way" . . . not that it is "a safe way." Competitive fuels aren't mentioned, but the inference is very strong. Copywriters for EEI's ads apparently do not know that electricity causes more fires annually than any other fuel.

Gas industry participation in the 1964 World's Fair in New York is off and running. A.G.A. and GAMA have announced formation of Gas, Incorporated, to plan and direct the creation and operation of a gas industry building on the fair grounds. John Heyke, president of Brooklyn Union Gas, is president of Gas, Inc. Other officers include vice president William G. Hamilton Jr., president of American Meter Company; treasurer, James Comerford, board chairman of Consolidated Natural Gas Company, and executive secretary, Stanley B. Finch, coordinator for the gas industry at the 1939 World's Fair.

Texas and Louisiana natural gas may journey to California via northern Mexico if plans of Tennessee Gas Transmission Company move from the "talking stage" to actuality. The giant gas firm is reportedly discussing plans for such a line with officials of the Mexican government. Petroleos Mexicanos, however, would not be able to participate in the venture. Mexican law prohibits participation in joint ventures. The Mexican government, though, would be involved as financing purportedly would include an issue of Mexican bonds, underwritten by TGT and a syndicate of U. S. banks. Plans include moving Louisiana and Texas gas to northern Mexico and Mexican gas to California.

Liquefied natural gas from Alaska for California customers? Pacific Lighting Corporation (subsidiaries: Southern Counties Gas, Southern California Gas, Pacific Lighting Gas Supply) is presently studying the feasibility of liquefying gas in the northernmost state and shipping it via tanker to southern California.

Coal interests, who have been actively promoting a national "fuels policy," showed their hand in Illinois, asking the Illinois Commerce Commission to halt the sale of gas as an interruptible boiler fuel. The coal people alleged in their complaint that rates charged for such service were "fixed at a price below coal," thus adversely affecting coal sales. In reply to the complaint, Peoples Gas Light and Coke Company (Chicago) asked the ICC to dismiss the action, noting that such sales were in the interest of the gas-consuming public at large and that such sales were made under standards set by the Illinois Supreme Court and by the state's Public Utility Act that allows public utilities to classify customers and charge different rates to each class.

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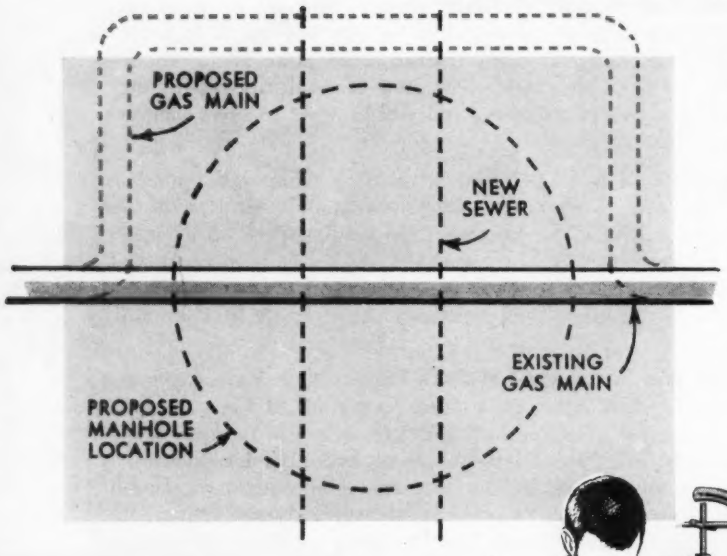
RELOCATE GAS LINES QUICKLY and SAFELY with

MUELLER® NO-BLO® METHOD

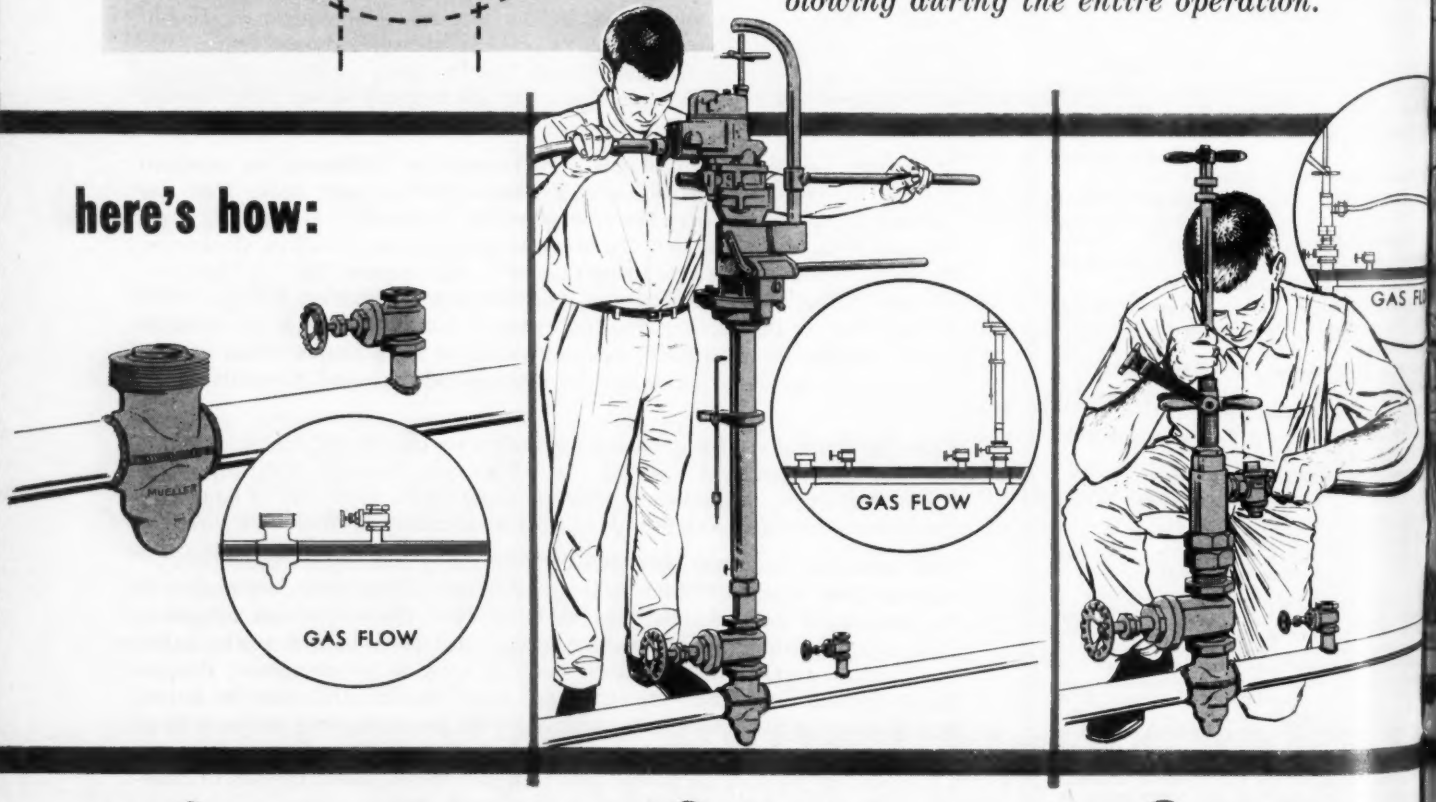
Machines and Equipment



■ Recently a new sewer trunk line and manhole installation posed a tough line relocation problem for a gas utility company. Serving an industrial and residential area, service could not be interrupted during relocation of the line.

This schematic diagram of the problem and the step by step illustrations show how the line was relocated with Mueller No-Blo Method Line Stopper Fittings and Equipment . . . *without interrupting service* and *without gas blowing during the entire operation.*

here's how:



STEP 1 ATTACH FITTINGS

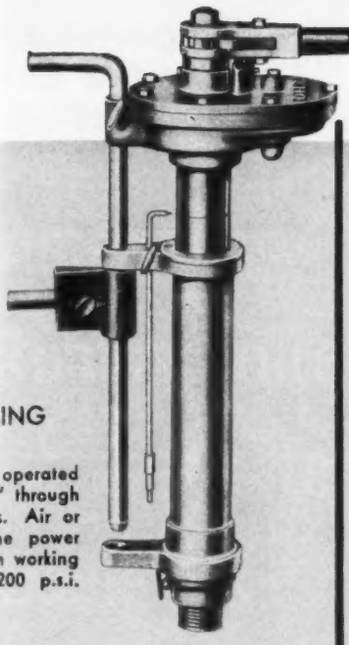
Weld Mueller Line Stopper Fittings to main on each side of section to be relocated. Weld Save-A-Valve Drilling Nipples to line providing by-pass and purging connections. Attach gate valves to drilling nipples.

STEP 2 DRILL MAIN

Attach special Mueller gate valve to stopper fitting. Attach DH-2 Drilling Machine (or D-4 Drilling Machine) to gate valve. Make cut, retract drill, close gate valve and remove drilling machine. Repeat cutting operation in second line stopper fitting and Save-A-Valve Drilling Nipples.

STEP 3 CONNECT BY-PASS

Attach line stopper to H-17135 Stopping ... chine and attach Machine to gate ... Connect by-pass line between the H-17... Stopping Machines. Purge by-pass, then ... flow through the by-pass line.



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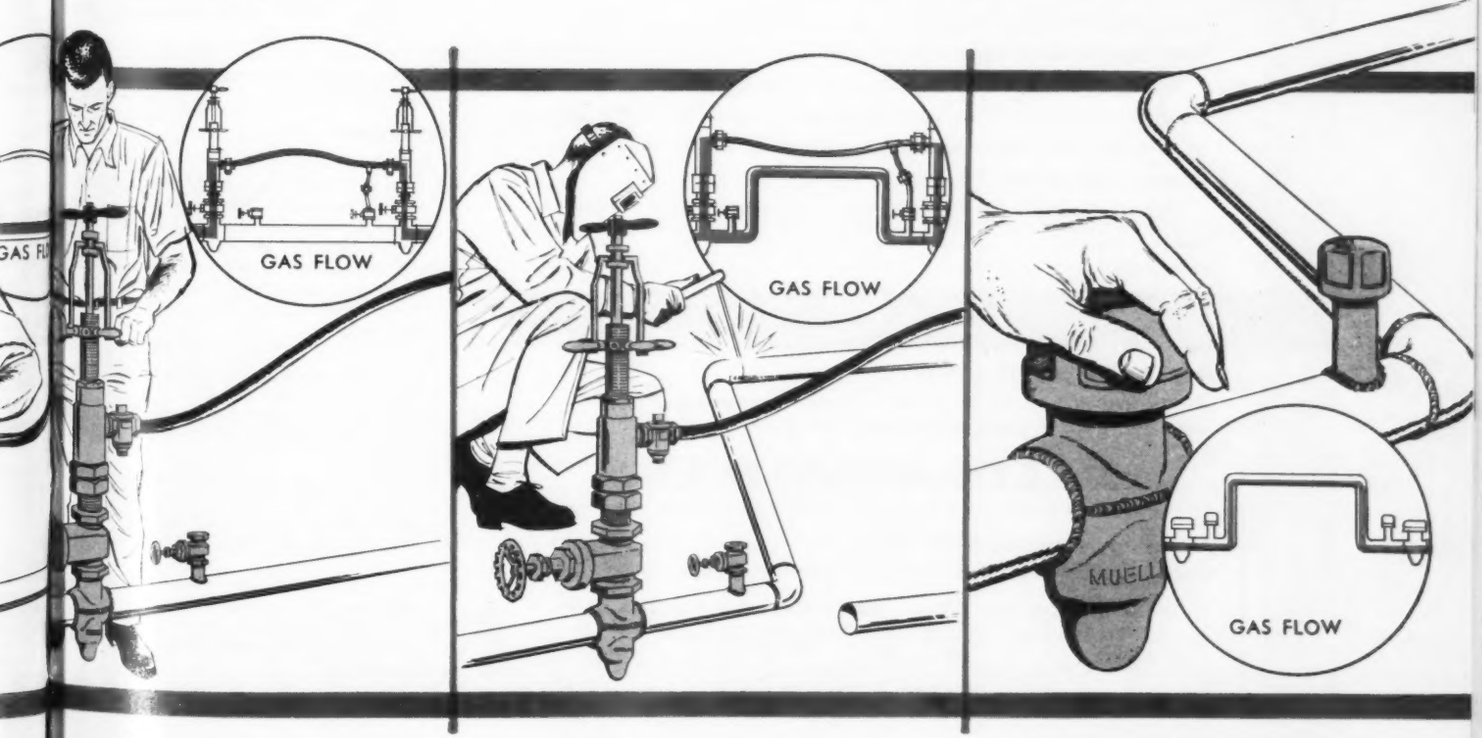

STEP 4 STOP-OFF

pen gate valve on upstream stopper fitng, insert and expand stopper. Repeat op-off operation on downstream stopper tting. Section is now isolated.

STEP 5 RELOCATE MAIN

With by-pass line maintaining flow of gas without interruption or shut-down, the isolated section can be removed and relocated. Test new welds before activating new section.

STEP 6 ACTIVATE MAIN

Purge isolated main section after welds have cooled. Using Unit #1 Stopping Machine, remove line stopper in downstream fitting and close gate valve. Then remove line stopper fitting in upstream fitting. Main section is now in operation. Remove by-pass. Plug and cap line stopper fittings and drilling nipples.

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COMING EVENTS IN THE GAS DISTRIBUTION INDUSTRY

September

9 New Jersey Gas Association, annual meeting, Essex and Sussex Hotel, Spring Lake, New Jersey.

9 A.G.A. Public Relations Achievement Award Judging, A.G.A. headquarters, New York City.

12-13 NEGA gas utility managers conference, Wianno Club, Massachusetts.

12-14 A.G.A. accident prevention conference, Leamington Hotel, Minneapolis, Minnesota.

14-16 A.G.A. Operating Section Committee on Underground Storage, Statler Hilton, Buffalo, New York.

15-16 A.G.A. Textile Processing Symposium, Sedgefield Inn, Greensboro, North Carolina.

15-17 Public Utilities Association of the Virginias, 42nd annual meeting, The Greenbrier, White Sulphur Springs, West Virginia.

18-21 ASME Petroleum Mechanical Engineering Conference, Hotel Jung, New Orleans, Louisiana.

19 Rocky Mountain Gas Association, 17th anniversary banquet, Denver Hilton Hotel, Denver, Colorado.

19-20 NEGA gas industry sales conference, Wianno Club, Massachusetts.

21-23 Southeastern Gas Association, annual meeting, Sir Walter Hotel, Raleigh, North Carolina.

21-23 PCGA annual meeting, Westward Ho Hotel, Phoenix, Arizona.

26-30 ISA fall instrument-automation conference and exhibit and annual meeting, New York Coliseum, New York, New York.

27-29 Mid-West Gas Association gas school and conference, Iowa State College, Ames, Iowa.

October

3- 4 Independent Natural Gas Association of America, annual meeting, Fontainebleau Hotel, Miami Beach, Florida.

4- 5 Gas Measurement Institute, National Guard Armory, Liberal, Kansas.

5- 7 Wisconsin Utilities Association, annual gas operating and sales convention, Schroeder Hotel, Milwaukee, Wisconsin.

6- 7 NACE western regional conference, Sheraton-Palace Hotel, San Francisco, California.

6- 8 NACE, southeast region conference, Dinkler-Plaza Hotel, Atlanta, Georgia.

10-12 A.G.A. annual convention, Atlantic City, New Jersey.

11-14 NACE, northeast region conference, Pritchard Hotel, Huntington, West Virginia.

17-21 National Safety Council, annual meeting, Chicago, Illinois.

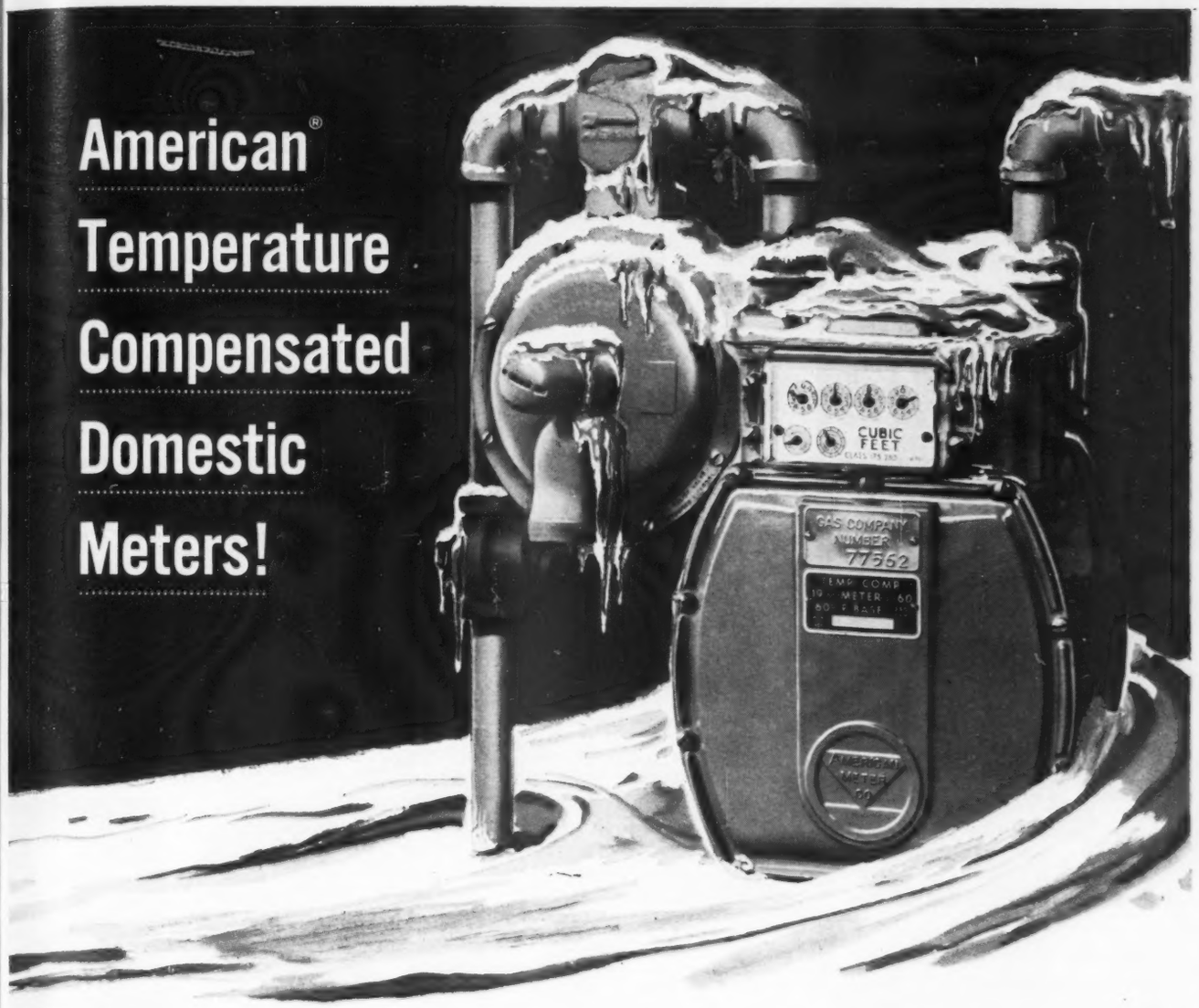
19 NEGA street dept. supervisory group, Hotel Bancroft, Worcester, Massachusetts.

19-20 NACE north central region conference, Schroeder Hotel, Milwaukee, Wisconsin.

21 NEGA commercial and industrial groups, Colonial Inn, Lynnfield, Massachusetts.

24-25 Independent Petroleum Association of America, annual meeting, Statler Hilton Hotel, Dallas, Texas.

Now, from the pioneers in temperature compensation...



Once again, American Meter Company research has made a tremendous contribution to the technological progress of the entire Gas Industry. Like every other American Meter advance, the Temperature Compensating Domestic Meters are an outgrowth of the Company's continuous search for *better* ways to serve the industry's needs. In fact, nearly 30 years have passed since American Meter introduced the first temperature compensating device for large Positive Displacement Meters—the Base Volume Index.

The new Temperature Compensator is continuing proof that the Gas Industry can count on American to develop the most modern, accurate measurement equipment. American has pioneered in meter progress since 1836—and will continue to bring progress through research!

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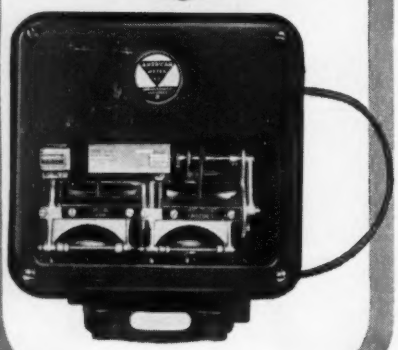
with an American® Base Volume Index



American Base Volume Indexes register the measured gas quantity at standard conditions of base pressure and base temperature on a direct reading counter. No computations... accurate gas volumes are shown continuously and immediately.

A second counter also indicates the gas volume at line conditions. Simple operating principle... integration is continuous with all functions performed mechanically through special gearing.

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MEN AT WORK

IN THE GAS DISTRIBUTION INDUSTRY

Recent Appointments

Jackson Kemper, former vice president and general manager of Forge and Fittings Div. of H. K. Porter Co., Inc. to executive vice president of Mueller Co.

James A. Kozel, former chief engineer of Appliance Controls Div. of Scoville Mfg. Co. to manager of product engineering for Detroit Controls Div. of American Standard.

Harold M. Small to sales manager for Buflovak Equipment Div. of Blaw-Knox Co.

Robert W. Allison to manager of newly-formed advertising department for Kraloy Plastic Pipe Co.

Parker S. Anderson to development engineer at Vulcan plant of Reeves Brothers, Inc. in Buena Vista, Virginia.

Ronald M. Roberts as sales representative for Atlanta sales district and **Edmund B. Lennig** as sales representative for San Francisco sales district for American Meter Co.

George F. Kelly as sales engineer in the New York district office of Industrial Silencer Div. of Burgess Manning Co.

Charles R. Docis to the advertising department of American Meter Co.

J. P. Knopf, secretary-treasurer of Tube Turns Plastics, Inc. since it was organized in 1954, to vice president of TTP.

Lawrence H. Stanley, industrial marketing consultant, to newly-created post of manager of marketing services for the six operating divisions of ACF Industries, Inc.

Recent Promotions

Roger C. Post, junior rate engineer, to rate engineer in Ohio Fuel Gas Co.'s general office in Columbus.

W. E. Long, assistant to the president, to sales manager of Houston Natural Gas Corp.

Ardmore J. Healy, division general sales and promotion manager, to assistant to the vice president of Lone Star Gas Co.'s Fort Worth (Texas) division of distribution.

John Daly to safety director of Minneapolis Gas Co.

Deaths

Eugene H. Bird, president of Boston Gas Co.'s parent, Eastern Gas and Fuel Associates. He was a director of Boston Gas Co. and Algonquin Gas Transmission Co.

Norman T. Shideler, corrosion consultant, formerly of Pittsburgh Coke and Chemical Co.

● Decentralization and functional reorganization of San Diego Gas & Electric Co.'s operation division has been initiated with the following appointments: **Walter A. Zitlau,** named manager-production and transmission; **Joseph F. Sinnott,** manager-engineering; and **C. Peter de Jonge,** manager-distribution. **Carthrae M. Laffoon** and **William A. Davis** have been assigned to posts of mechanical engineer and chief design engineer respectively.

● **Jack A. Bell** has been elected executive vice president of Gas Light Co. of Columbus in what company calls a reorganization of the duties and responsibilities of officers of the company. **Frank D. Foley** continues as president and **Charles K. Oxford** as vice president.

● Newly-elected president and chief executive officer of Boston Gas Co.'s parent, Eastern Gas and Fuel Associates, is **Robert P. Tibolt** who succeeds the late Eugene H. Bird. Tibolt has been executive vice president of Eastern Gas since 1955.

● **Thomas Weir,** vice president and general manager of Union Gas Company of Canada, Limited, and Ontario Natural Gas Storage and Pipeline Limited, has retired. He is succeeded as general manager by **F. R. Palin,** who was formerly the assistant general manager, secretary and treasurer. Palin will retain the office of treasurer but is succeeded as secretary by **J. W. S. McOuat.**

● Southern Counties Gas Co.'s new assistant engineer, construction and distribution department is **Dick Donaldson.**

● **Charles H. Petek,** superintendent of general accounting, Washington Natural Gas Co. has been named assistant treasurer of the company.

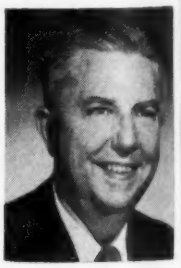
● **William Lawlor Jr.,** vice president and operating manager of Southern Union Gas Co. in Austin, has retired after more than 53 years of service in the natural gas industry.

● Michigan Consolidated Gas Co. has appointed **Paul W. Weber** director of public information. He was formerly public information director of the Michigan Civil Service Commission.

E. T. Hollifield

G. W. Adams

F. E. Neeley



P. C. Avant

● Twelve employees promoted at Atlanta Gas Light Co. are **E. T. Hollifield** to Macon manager; **George W. Adams,** operating superintendent in Atlanta; **Fred E. Neeley,** production and building superintendent in Atlanta; **P. C. Avant,** chief engineer; **John E. Lester,** Macon superintendent; **W. F. Bennett,** assistant chief engineer; **Thomas C. Bush,** Augusta superintendent; **John D. Roberts,** Athens superintendent; **Joseph S. Hornston,** assistant service superintendent; **Stanley G. Wood,** to executive assistant; **William F. Norman,** Atlanta division engineer and **William T. Raines,** to Waycross superintendent.

NO-OX-ID® 6X joint blocks save time, money, trouble

Dearborn's Pipe Line Primer, NO-OX-ID 6X Joint Blocks and NO-OX-IDIZED Wrapper are an unbeatable combination for long-lasting protection of welded pipe joints. And there's nothing on the market like Dearborn's aerosol Primer packaging. Eliminates dope cans, brushes, spillage, waste. Always ready for use instantly . . . at the touch of a finger.

6X Joint Blocks can be used with all types of mill or yard applied coatings . . . are cheaper and faster than other joint protection materials.

Available in 8-pound packages, they are easily handled . . . require no cumbersome heating equipment . . . will not coke in the heating kettle . . . can be reheated without impairment . . . can be added to as needed on the job. Workers like them because they are non-toxic, give off no noxious fumes, cause no chemical burns.

Call a Dearborn representative for additional information on advantages and economies or write for Technical Bulletin giving application methods.

DEARBORN CHEMICAL COMPANY

General offices: Merchandise Mart, Chicago 54—Dallas • Des Plaines, Ill. • Ft. Wayne • Honolulu Linden, N.J. • Los Angeles • Nashville • Omaha • Pittsburgh—Toronto • Havana • Buenos Aires

pioneer in the science of corrosion control

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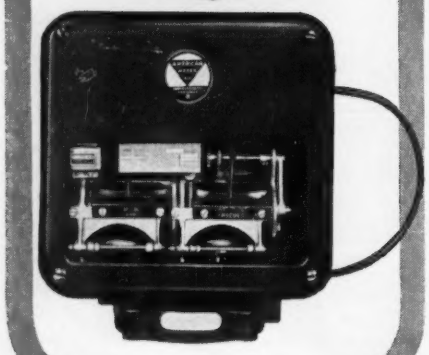
Accurate Flow Volumes at All Times

with an American® Base Volume Index



American Base Volume Indexes register the measured gas quantity at standard conditions of base pressure and base temperature on a direct reading counter. No computations... accurate gas volumes are shown continuously and immediately.

A second counter also indicates the gas volume at line conditions. Simple operating principle... integration is continuous with all functions performed mechanically through special gearing.

Write for Bulletin 200 for complete information.

AMERICAN METER CO. EST. 1836 MEASUREMENT ENGINEERS

AMERICAN METER COMPANY

INCORPORATED Estab.-Shed 1836

General Offices: Philadelphia 16, Pa.
Sales Offices in Principal Cities

MEN AT WORK

IN THE GAS DISTRIBUTION INDUSTRY

Recent Appointments

Jackson Kemper, former vice president and general manager of Forge and Fittings Div. of H. K. Porter Co., Inc. to executive vice president of Mueller Co.

James A. Kozel, former chief engineer of Appliance Controls Div. of Scoville Mfg. Co. to manager of product engineering for Detroit Controls Div. of American Standard.

Harold M. Small to sales manager for Buflovak Equipment Div. of Blaw-Knox Co.

Robert W. Allison to manager of newly-formed advertising department for Kraloy Plastic Pipe Co.

Parker S. Anderson to development engineer at Vulcan plant of Reeves Brothers, Inc. in Buena Vista, Virginia.

Ronald M. Roberts as sales representative for Atlanta sales district and **Edmund B. Lennig** as sales representative for San Francisco sales district for American Meter Co.

George F. Kelly as sales engineer in the New York district office of Industrial Silencer Div. of Burgess Manning Co.

Charles R. Docis to the advertising department of American Meter Co.

J. P. Knopf, secretary-treasurer of Tube Turns Plastics, Inc. since it was organized in 1954, to vice president of TTP.

Lawrence H. Stanley, industrial marketing consultant, to newly-created post of manager of marketing services for the six operating divisions of ACF Industries, Inc.

Recent Promotions

Roger C. Post, junior rate engineer, to rate engineer in Ohio Fuel Gas Co.'s general office in Columbus.

W. E. Long, assistant to the president, to sales manager of Houston Natural Gas Corp.

Ardmore J. Healy, division general sales and promotion manager, to assistant to the vice president of Lone Star Gas Co.'s Fort Worth (Texas) division of distribution.

John Daly to safety director of Minneapolis Gas Co.

Deaths

Eugene H. Bird, president of Boston Gas Co.'s parent, Eastern Gas and Fuel Associates. He was a director of Boston Gas Co. and Algonquin Gas Transmission Co.

Norman T. Shideler, corrosion consultant, formerly of Pittsburgh Coke and Chemical Co.

● Decentralization and functional reorganization of San Diego Gas & Electric Co.'s operation division has been initiated with the following appointments: **Walter A. Zitlau,** named manager-production and transmission; **Joseph F. Sinnott,** manager-engineering; and **C. Peter de Jonge,** manager-distribution. **Carthrae M. Laffoon** and **William A. Davis** have been assigned to posts of mechanical engineer and chief design engineer respectively.

● **Jack A. Bell** has been elected executive vice president of Gas Light Co. of Columbus in what company calls a reorganization of the duties and responsibilities of officers of the company. **Frank D. Foley** continues as president and **Charles K. Oxford** as vice president.

● Newly-elected president and chief executive officer of Boston Gas Co.'s parent, Eastern Gas and Fuel Associates, is **Robert P. Tibolt** who succeeds the late Eugene H. Bird. Tibolt has been executive vice president of Eastern Gas since 1955.

● **Thomas Weir,** vice president and general manager of Union Gas Company of Canada, Limited, and Ontario Natural Gas Storage and Pipeline Limited, has retired. He is succeeded as general manager by **F. R. Palin,** who was formerly the assistant general manager, secretary and treasurer. Palin will retain the office of treasurer but is succeeded as secretary by **J. W. S. McOuat.**

● Southern Counties Gas Co.'s new assistant engineer, construction and distribution department is **Dick Donaldson.**

● **Charles H. Petek,** superintendent of general accounting, Washington Natural Gas Co. has been named assistant treasurer of the company.

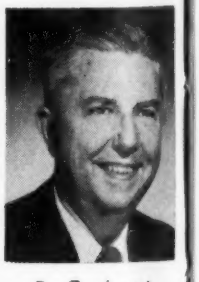
● **William Lawlor Jr.,** vice president and operating manager of Southern Union Gas Co. in Austin, has retired after more than 53 years of service in the natural gas industry.

● Michigan Consolidated Gas Co. has appointed **Paul W. Weber** director of public information. He was formerly public information director of the Michigan Civil Service Commission.

E. T. Hollifield

G. W. Adams

F. E. Neeley



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dearborn

pioneer in the science of corrosion control

SAVE MONEY

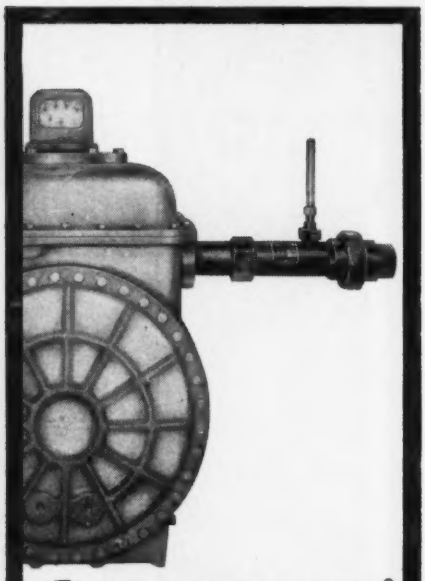
no meter set and removal expenses

SAVE TIME

on-the-spot proof testing

SAVE EFFORT

no hauling meters to shop



AMERICAN®

FLOW PROVERS

Light weight and portable. Quick, accurate, in-the-field proof testing of high capacity positive displacement meters.

AMERICAN LOW PRESSURE FLOW PROVERS for testing meters with air or gas at pressures below 15 psi. Calibrated orifice discs for capacities ranging from 100 to 10,000 cfh.

AMERICAN CRITICAL FLOW PROVERS for testing high pressure displacement meters. 1000 psi maximum working pressure. Available in 2-inch size with gas capacities from 250 to 6000 cfh.

AMERICAN®
METER COMPANY

General Offices: Philadelphia 16, Pa.
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Men at Work

● **J. Theodore "Ted" Kennedy** is the new public relations director for Kansas-Nebraska Natural Gas Co. succeeding **James J. Diesing** who has accepted a position with Northern Natural Gas Co. of Omaha.

J. T. Kennedy

Neal Hall

● **Neal Hall** has been appointed to the new post of publicity and advertising director for Lone Star Gas Co. **Bruce Cunningham** moves up to manager of press relations, a new position in the publicity and advertising department; he will be assisted by **Alex L. Acheson,** publicity representative, and **Anne Schuler,** publicity staff writer. Other departmental changes include appointment of **Mrs. Claribel Thompson** to the new post of supervisor of organization publicity; succeeding her as editor of *Blue Blaze* is **Joel Horton,** formerly assistant editor.

● New editor of Iowa Electric Light and Power Co.'s *The Front Line* is **Marilyn Small;** she succeeds **Marian McNutt,** who is assuming other duties in the advertising department.

● American Gas Association's new Bureau of Statistics rate specialist is **Irwin S. Schwimmer,** who has been a member of the bureau staff for 12 years, and was recently appointed assistant director of the bureau.

● Electro-Mechanical Research, Inc. has established a new district office in Houston headed by **Maurice C. Superville** who was formerly sales engineer in the Houston area for Vapor Recovery Systems Co.

● Washington Natural Gas Co., Seattle, has elected **William P. Woods,** former vice president of Stone & Webster Service Corp., as president of the company following the retirement of **Charles M. Sturkey.**

● Cleveland Trencher Co. has appointed **J. Rowland Doyle** as chief engineer. He was formerly assistant chief engineer with the Oliver Corporation.

J. R. Doyle

R. S. Burke

● **Richard S. Burke** has been elected president and director of the Geo. D. Roper Corp. **Stanley H. Hobson,** who has been both chairman of the board and president, will continue as board chairman and play an active role in the company's management. Previously, Burke has been operating assistant to the president of Sears, Roebuck and Co.

● U. S. Industries, Inc., has announced the resignation of **R. A. Stumm** as vice president and as board chairman of its Southern Pipe Division. As founder of Southern Pipe & Casing Co. in 1932, Stumm has served Southern Pipe as chief executive for 27 years, and for the past year as board chairman. **D. A. Stromsoe,** president of Southern Pipe since December 1957, will continue to actively operate the division.

● **Floyd Gaunt,** veteran of almost a half-century in the gas industry, is retiring as vice president and general manager of Reynolds Gas Regulator Co., Inc., but will remain as consultant to the firm. **Robert E. Wellborn,** gas distribution engineer in Arkansas division of Arkansas Louisiana Gas Co., succeeds Gaunt as general manager.

● **Hugh W. Baird,** president and board member of Standard Pipeprotection, Inc., pipe coating and wrapping firm, has been elected to the board of directors of Midwest Piping Co., Inc.

R. E. Garrett

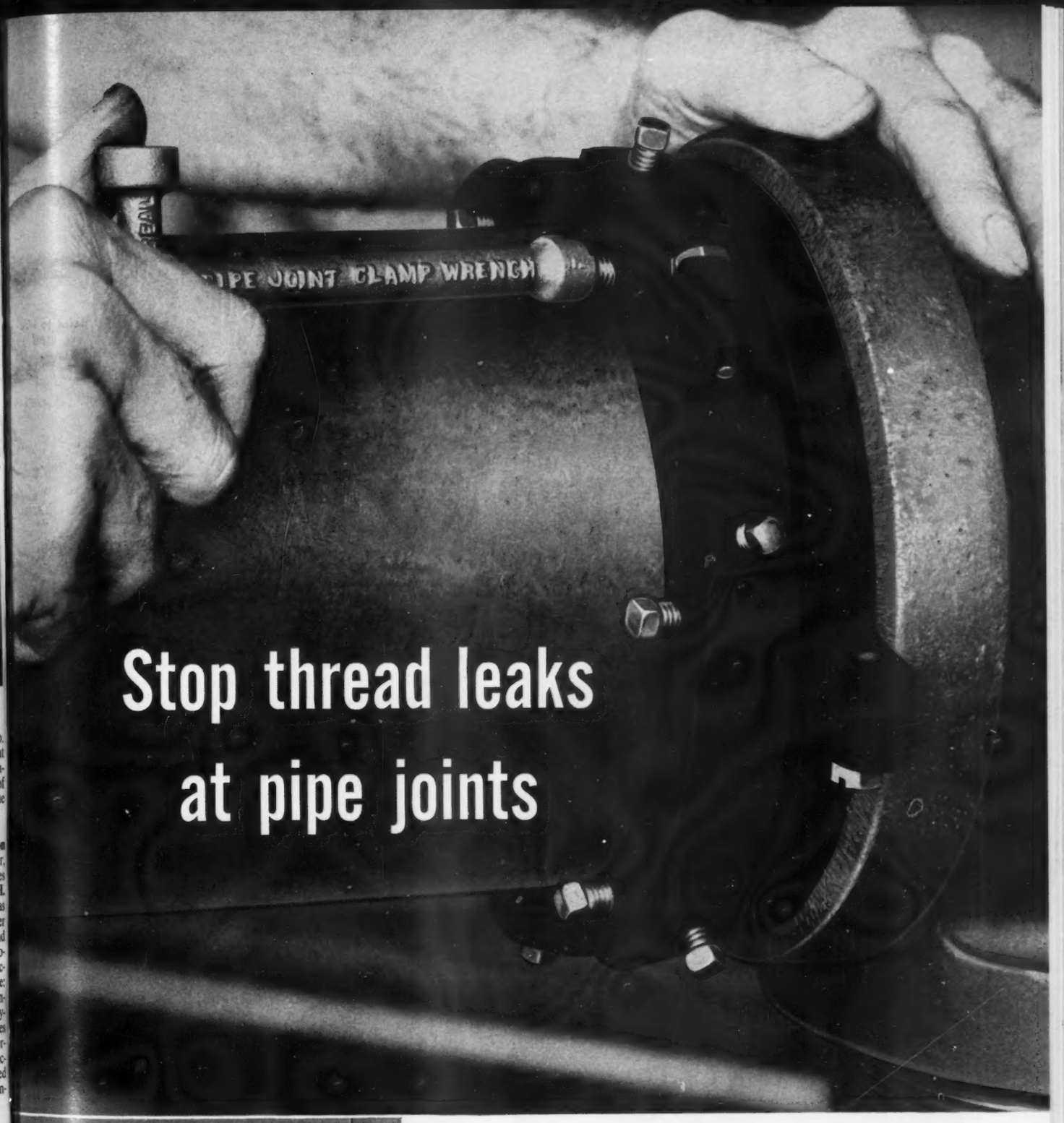
C. S. Lawson

● United States Pipe and Foundry Co. has elected **Robert E. Garrett** president and chief executive officer of the company effective with the retirement of **Claude S. Lawson.** Lawson will continue as chairman of the board.

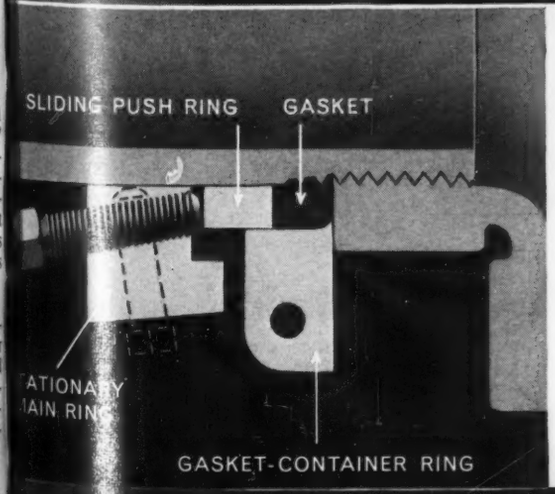
● Promotion of **Chester F. Worthington** to east-central regional sales manager, prompts two other organizational changes at Whirlpool Corp. — promotion of **H. Thomas Stroop,** sales manager for gas refrigerators, to Worthington's former post of refrigerator sales manager and **Stephen E. Upton,** advertising and promotion manager, utility division, to succeed Stroop. Other promotions include: **W. Klee Grumbine** to sales training, manager, succeeding **L. M. Snyder,** recently-named manager of the new Florida sales division; **William C. Hume,** former corporate manager of quality control succeeds **Evans T. Morton,** who has resigned as refrigerator and freezer product manager.

● **Richard D. Hall,** sales representative in Pacific Southwest, has moved to the newly-created post of manager, distributor sales for Grayson Controls Div., Robertshaw-Fulton Controls Co. Hall will also serve as assistant to **M. F. "Mike" Grace,** recently-named product sales manager for central heating controls. In Chattanooga, Tenn., **Samuel D. Houston** succeeds Grace as Southern territory district sales manager, and **Floyd Fost** succeeds Houston as sales representative in Dallas sales office.

● Heading Columbia Gas System Service Corp.'s new gas engineering section for developing applications for high speed computers for system engineering and operations is **John E. Towle.** He was formerly engineer in the methods department.



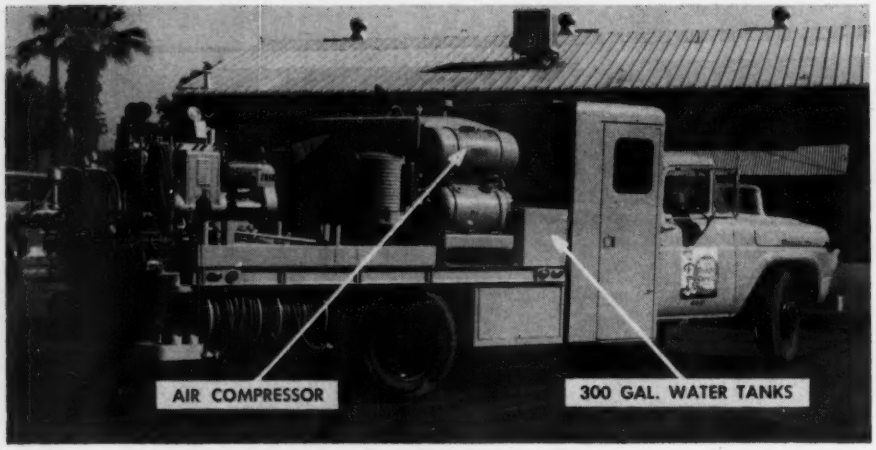
Stop thread leaks at pipe joints



SKINNER-SEAL PIPE JOINT CLAMP stops leaks at joints where pipe is screwed into fitting. Pressure? On sound joints, effective up to 2,000 p.s.i. Saves the cost of tearing out and renewing leaky fittings. Prevents shutdowns. Has served industry 60 years. Stocked by most distributors.

M. B. SKINNER CO., SOUTH BEND 21, INDIANA

SKINNER-SEAL PIPE JOINT CLAMP



Packed full of ideas, No. 4641 is the latest and most efficient in a family of efficient, mobile, gas department tools at Arizona Public Service Company. Arrows point to 300-gal water tank and air compressor used to power pneumatic tools and a pneumatic water pump. In arid Arizona, water is needed for compacting bellholes, etc.

For gas maintenance and service . . .

'Brainstorming' Helps Develop Idea-Oriented, Double-Duty Vehicles

Tom Keefe, *Arizona Public Service Company, Phoenix, Arizona*

ARIZONA PUBLIC SERVICE COMPANY has discovered a foolproof formula for developing gas maintenance and service vehicles that are efficient, safe and comfortable:

Take one part operating people, one part transportation section, and one part craft shops; for a catalyst use a liberal amount of communications. Do some "brainstorming," get all of the ideas together, and maintain communications.

The results are saving real money for Arizona Public Service in increased efficiency of crews. Customer relations, too, are helpful with planned maintenance and emergency maintenance interruption time reduced considerably.

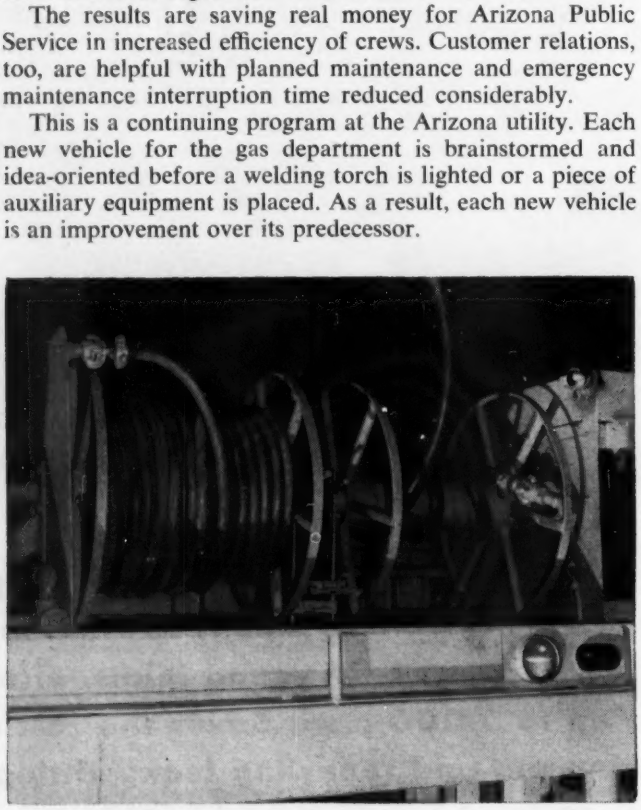
This is a continuing program at the Arizona utility. Each new vehicle for the gas department is brainstormed and idea-oriented before a welding torch is lighted or a piece of auxiliary equipment is placed. As a result, each new vehicle is an improvement over its predecessor.

For example, take a look at Public Service vehicle No. 4641. In the embryo stage it was just another 1½-ton truck chassis. Then the "formula" was activated, and today No. 4641 is the latest and most efficient in a family of efficient, mobile, gas department tools.

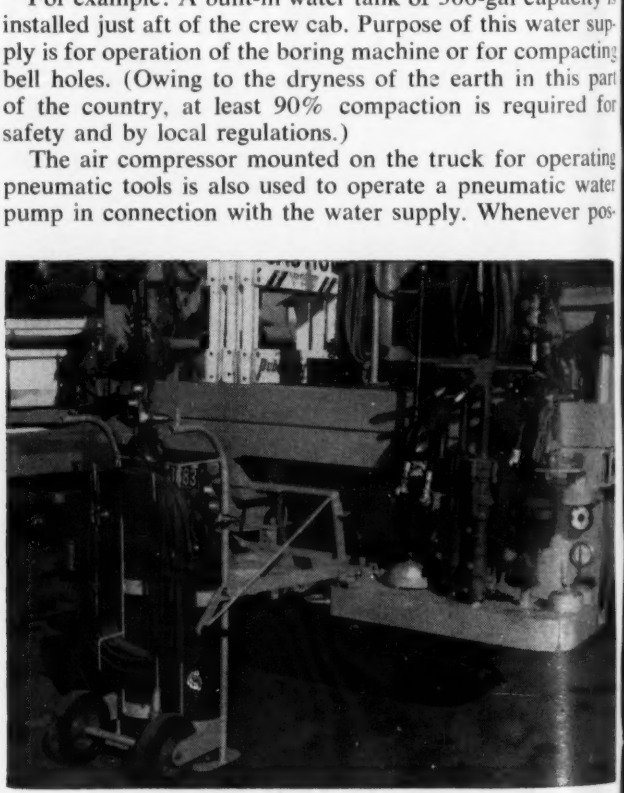
Designed and equipped for planned and emergency maintenance, No. 4641 has some interesting new features.

For example: A built-in water tank of 300-gal capacity is installed just aft of the crew cab. Purpose of this water supply is for operation of the boring machine or for compacting bell holes. (Owing to the dryness of the earth in this part of the country, at least 90% compaction is required for safety and by local regulations.)

The air compressor mounted on the truck for operating pneumatic tools is also used to operate a pneumatic water pump in connection with the water supply. Whenever pos-

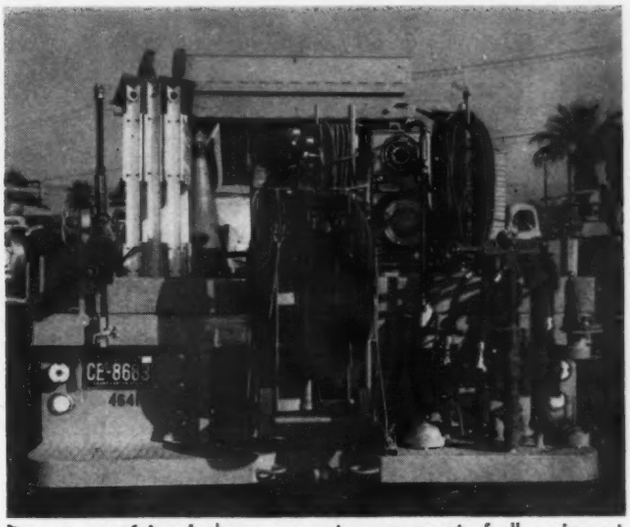


Special hose reels were developed in APS' crafts yard. Connecting hose to either water or air supply fastens hose to reel. Valves make use of water or air interchangeable — or both hoses can be used at same time for either water or air. Reels are crank driven at rear of vehicle.



Safety comes first. All standard pneumatic tools and a swiveling pipe vise are mounted on right rear side of truck. Crew members using tools are given minimum exposure to road and highway traffic when truck is parked along thoroughfares. In foreground is oxygen-acetylene welding cart that mounts in center of back bumper on a lifting device to facilitate its use.

Small tool and parts bins are also placed on right side of vehicle.



Rear view of truck shows compact arrangement of all equipment. Left rear side of truck provides cargo space for blinker-type barricade devices, cones, and other materials.

sible, double-duty equipment is an important part of the efficiency scheme in Arizona Public Service vehicle planning.

A pair of innovations are the special hose reels developed in the crafts yard. Connections with either the water or air supplies fasten the hose to the reel. Valves make interchangeable the use of water or air, or both hoses may be used at the same time for one. The reels are driven from a crank at the rear of the vehicle.

An interesting safety approach is the use of the truck's back bumper — on the right side — for storage and transportation of standard pneumatic tools and a swiveling pipe vise. Although — from a weight standpoint — this is not necessarily desirable, it is an inherent safety feature. Crew members using the tools are under minimum exposure to road and highway traffic when it is necessary to park the truck along thoroughfares.

In addition, this right-hand placement of tools affords a convenient point of access from the left-hand side of the vehicle's cargo space and other auxiliary equipment on the bed. Small tool and parts bins are also placed on the right side of the vehicle.

Truck No. 4641 carries a 200-amp direct-current electric welding unit. This is portable and is mounted in such a manner that it may be set off on a job in spite of its 590-lb weight. Welding tools also include an acetylene welding cart with 125 ft of hose, a 110 cu ft oxygen tank and a 110 cu ft acetylene tank. This equipment is mounted in the center of the back bumper on a lifting device to facilitate its use.

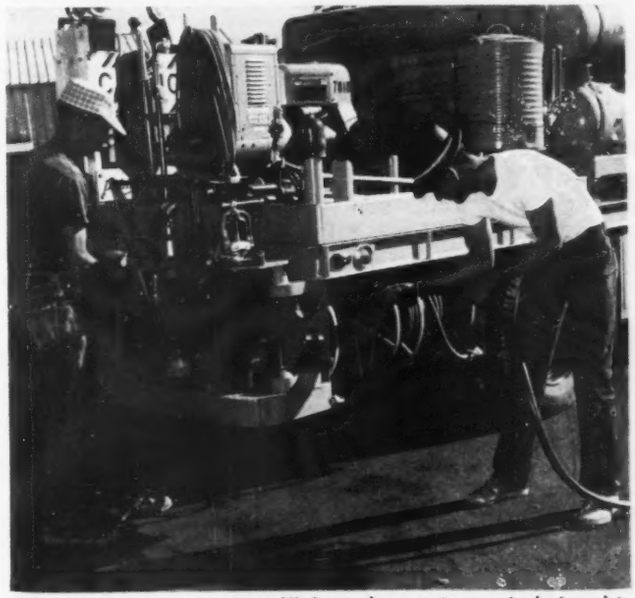
Racks for carrying blinker-type barricade devices are placed at the rear of the truck bed for ease of removal.

Radio-equipped, No. 4641 makes it a simple matter for the foreman of the maintenance crew of four men, to call for reinforcement by other maintenance crews in the event additional manpower is required. Job location routing and dispatching are also handled by radio.

Arizona Public Service purchases crew cabs for its vehicles from an outside vendor. These are prefabricated to company specifications and mounted by the utility. Truck No. 4641 can carry seven men including the driver. The window in the rear of the truck cab is removed for the sake of ventilation and communication between crew members.

According to Earl M. Jorgensen, gas operations manager for Public Service, "Cooperation, good communications and some creative thinking in our vehicle program continue to pay big dividends. We are sold on this program from the efficiency and safety points of view. Everyone connected with the program is understandably proud of its success."

* * *



Crew members are more efficient when equipment is designed to help them do work safer, better, and faster. Truck #4641 was designed and equipped expressly for planned and emergency maintenance service.

Crew cabs are prefabricated to company specifications and mounted by APS. Truck #4641 carries seven men including driver. Window in rear of truck cab is removed for ventilation and communication. Truck is radio-equipped.

Q: What Can Automation Save Us?

A: Plenty!

Automation . . . in the form of instrumentation, controls, computers, devices that "think and do," and many other modernistic developments . . . are helping solve problems of increasing costs of materials, equipment, labor and purchased gas

John L. Turnan, *Manager, Production and Transportation, Worcester Gas Light Company, Worcester, Massachusetts*

AUTOMATION is one of the most talked of subjects in the gas industry today. With the ever-increasing costs of purchased gas, pipe, labor, etc., automation holds an important spot in our economics.

One of the most useful forms of automation is telemetering of instruments and transmission of signals to perform functions such as starting equipment, changing flows or pressures, opening and closing valves, and many others.

Until recently, most telemetering and/or supervisory control required a pair of telephone wires for each function performed. With the introduction of tone equipment, as many as 28 functions can be performed by sending signals over the same wire at the same time. Tone equipment is accomplished using either radio tubes or transistors.

Worcester Gas Light has seven stations on one pair of telephone wires using tone equipment. A typical unit is one originating at the Farnumsville Natural Gas Take Station. Here, we record the flow of both runs at the station, pressure on the distribution system at the outlet of the station, and a flow controller for changing flows. This line also picks up the orifice meter station at Wyman-Gordon Company, a large industrial customer using over 2,000,000 cu ft per day. This pair of wires costs about $30.00 a month. Under the old system, for seven functions, seven pairs would cost $210.00 a month.

With the increasing complexity of load dispatching and additional sources of supply from gas transmission companies, the industry began looking for methods, other than manual, to aid the load dispatcher in logging purchased gas data.

Corrected Q Computers

Most recent development in this field is the Corrected Q, or volume computer. In a typical three-tube meter station, the pressure differential, absolute pressure, and flow temperature are scanned by transducers and fed into slide wire receivers.

Uncorrected totalized flow is fed into a computer transmitter, which then telemeters the corrected flow in the conventional manner to the dispatching office. The totalizing and correcting components can be located at the receiving end. An additional feature of this installation is that it has a printout device that types corrected totalized flow onto a tape each hour.

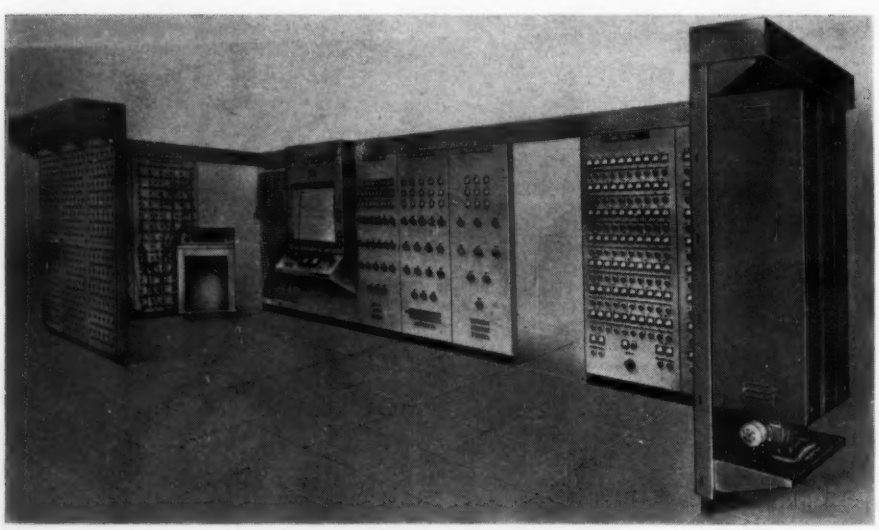
The next step that could be taken is corrected totalized flow that would be fed into a digital computer; all the data normally done manually, such as amounts taken up to a certain time, and amounts left to go in the contract day, would be done automatically.

At all of our natural gas stations we have installed fully automatic plants for controlling Btu. We modify to 1004 Btu in Worcester.

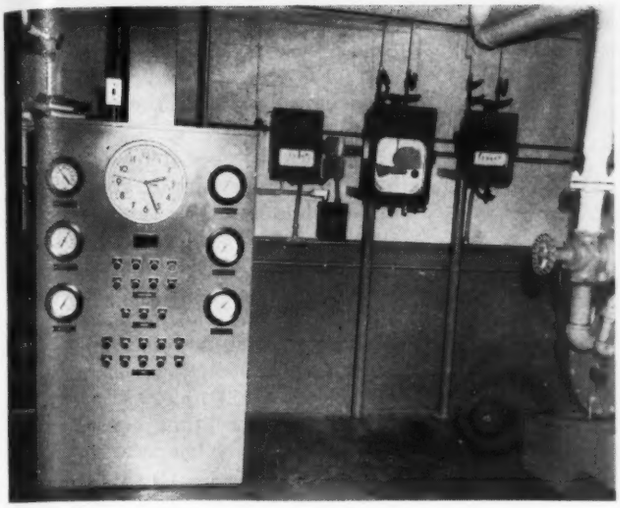
Peak Shaving With Holders

For those of us who are fortunate enough to have holders, some of the peak days can be handled with them. With the increased sendouts and higher pressures required, in a good many cases, the holder does not throw enough pressure. To utilize the holders efficiently, gas blowers or compressors powered by electric motors, diesel engines or gas-fueled engines are used. We use a high pressure jet compressor for this purpose. We use our high pressure gas for inspirating gas from the holder.

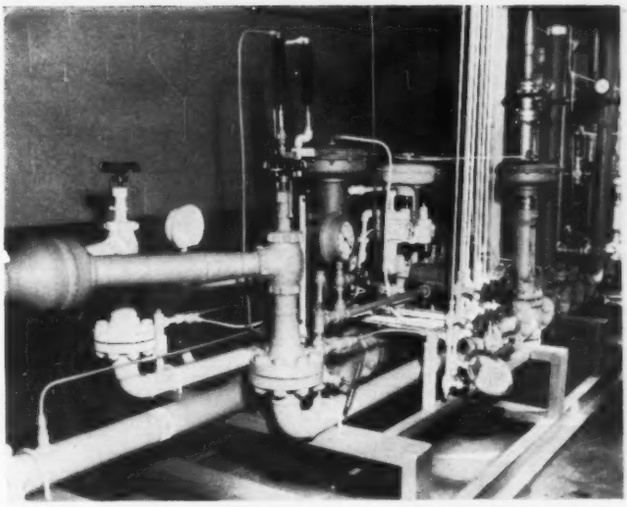
This equipment is automatically controlled. The required pressure is maintained by the pressure controller. This also is used for controlling the humidity of the gas going into the low pressure system. By controlling this, we have eliminated practically all frozen services.



Automation in action . . . McIlroy fluid network analyzer, sponsored by a group of Massachusetts gas companies, has been installed at Tufts University in Medford, Massachusetts. Analyzer is used by sponsoring gas utilities for evaluating present distribution systems, aids in designing new systems and extensions to existing systems.



Control panel of fully automatic high pressure propane-air peak shaving plant. Unit is remotely started, operated, and shut down from a point 16 miles away.



Mixing equipment in the automatic propane-air plant maintains a constant Btu output and has almost instantaneous adjustment to flow rate variations.

Through investigation, we have found that as the atmospheric temperature got below 14 F we began to get frozen services. With the dry natural gas mixing with the wet gas from the holder, the dew point was lowered enough to eliminate frozen services.

As the temperature falls, most of us have to increase the pressure on our low pressure systems. We are working on the installation of a temperature control for this jet. As the temperature drops, the controller automatically increases the distribution pressure; or decreases it, as the temperature rises. This eliminates human failure and poor pressure complaints. In conjunction with this, we have high pressure regulators set to cut in if anything should happen to the system.

Propane-Air Peak Shaving

Because of ever-increasing prices of natural gas and the changes in the peak shaving gas supply from our gas transmission company suppliers, peak shaving becomes important.

The plant we have installed at our Hudson Take Station is the first fully automatic, remotely controlled, unmanned, high pressure propane-air mixing plant to go into operation. It is controlled by telemetering from a point about 16 miles away, and is remotely started, operated, and shut down, and can be operated independently of any power failures.

Basically, the mixing plant has two orifice runs, with two pressure regulators for maintaining constant pressures on each run. Instead of two orifice plates, we use two Hancock flow control valves for the required volume of air and propane for the Btu required. These valves have calibrated figures on them that may be used if any change in Btu is required.

The unit is good for 80 Mcf per hour, or approximately 2,000,000 cu ft per day, and can be doubled by the installation of one more compressor and tank. This plant cost about $70,000 and the automatic equipment cost about $15,000—about $35 per thousand capacity.

The advantages of this mixer are:

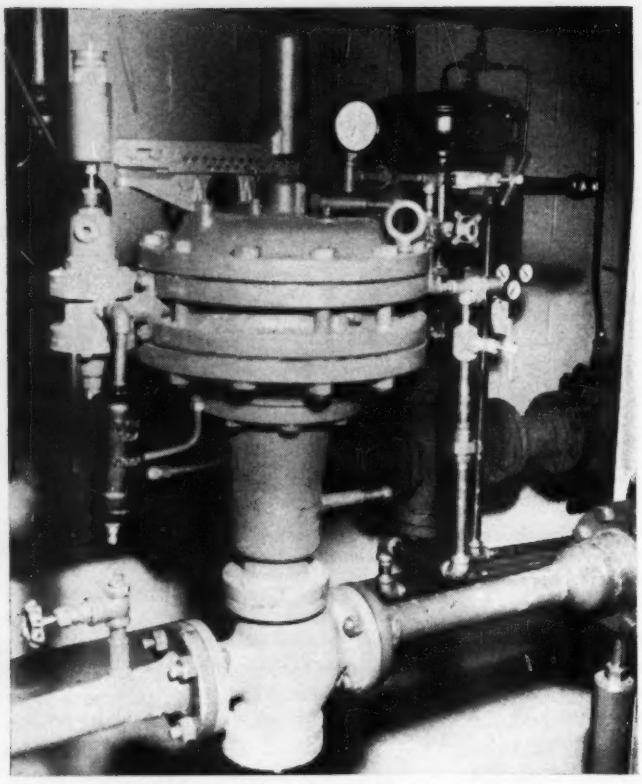
1. Practically instantaneous adjustment to flow rate variations without Btu variation.
2. Only two basic moving parts required. These are pressure regulators with which a normally skilled serviceman is familiar.
3. Shipped as a package, completely assembled and pretested.
4. Control panel shipped as a package complete with flow meters, flow controllers, or any equipment dictated by the needs of a particular situation.
5. By changing one selector switch, the control panel can be bypassed in case of control failure and the unit continues to operate automatically with only basic elements of the system functioning.
6. This system can be furnished for any capacity and any line pressure.
7. The basic safety device is a differential pressure switch. As long as differential pressure across pre-set orifices is within prescribed limits, the Btu of output is constant. This is a **straight line variable;** therefore, **no complicated instrumentation is required to get positive safety control.**
8. Unit can be put on the line at an **assured** Btu content within a matter of seconds.
9. Turndown ratio can be extremely wide. (One plant now in operation at Plymouth, Massachusetts, has a 250 to 1 turndown ratio, all fully automatic.)
10. Easy and economical to maintain.
11. No highly skilled operators required.
12. The system is as simple as a low pressure constant rate jet mixer, yet will handle highly variable loads and will produce any desired sendout pressure.
13. The unit works on a differential pressure principle, therefore, it is just as accurate at 200 psi sendout pressure as it is at 5 psi sendout pressure.

We also have installed, at the Milford Plant, a fully automatic, remotely controlled, unmanned, low pressure jet compressor. The controls used are identical to the ones just explained. This can be built to automatically control Btu and the percentage of propane in the system.

Automation in Distribution

Automatic pressure control becomes almost a must in our business today, if we are going to render adequate service and minimize the number of customer complaints. We are all familiar with computers for planning distribution systems and forecasting loads in the future.

As mentioned before, propane plants have other uses in distribution. The electric industry is using small package electric generators for supplying new housing developments, or when existing facilities are too small. Electric companies are building these plants with diesel or jet engine driven generators. They are set on a concrete slab and connected to the system. They are usually planned for from 2 to 5 years' use and, in some cases, merely to delay a larger investment for a few years.



Time-temperature booster installed at Worcester Gas Hudson station. Device "anticipates" load change of system using a pre-set timer. Booster is also sensitive to temperature changes and increases outlet pressures in proportion to incremental drops in temperature . . . overriding the "time" boost if necessary.

A packaged propane-air gas plant is ideally suited for this same problem. The distribution system could be laid and supplied until such time as lines could be extended to it. In many cases, they could be used to delay the laying of long lines to certain sections of our present system. We are considering such an installation to defer the laying of three miles of 8-in. main. Here, a fully automatic plant could be used on the 10 or 12 peak days when you might be in trouble. It could also be used instead of, or in conjunction with, hortonsphere storage tanks.

We have a hortonsphere installed in a section that has grown so fast that during a three-day cold spell we use all the gas in the hortonsphere and don't have gas or line pressure enough to refill it for days afterward and, in some cases, before it is needed again. Here, again, these fully automatically controlled plants would fit in well for peak shaving or for hourly pressure control.

Booster Regulators

Pressure-boosting regulators have been a useful gas industry tool for many years. Primarily developed for low pressure distribution systems, ("Cleveland" control, etc.), the velocity type booster principle has been adapted to high pressure distribution operations.

Basic scheme behind regulators that boost outlet pressure because of increase in demand is to maintain adequate pressure at some predetermined low point in a distribution system. Its adoption by industry is another evidence of the acceptance of automation. Rather than let pressure-vs-load requirements stay in the hands of people likely to make errors, it is better to use a piece of equipment capable of doing the same job.

With the advent of looped systems with many sources of gas, such boosters were the only answer to unmanned "plants." The most recent developments in this type of equipment have been boosters whose loading information comes from a source other than that of velocity (or pressure drop across an orifice).

The Fisher-King time temperature booster represents a step forward. These are boosters that *anticipate* load before it actually occurs. A time booster depends upon the behavior of a system during the day. If peak loads occur between 6 and 8 a.m., a pre-set timer begins loading at, say, 5 a.m., to "pack up the lines."

A temperature booster is sensitive to changes in atmospheric temperature. Usually, they are designed to increase outlet pressures in proportion to incremental drops in temperature. For instance, a five degree decrease in temperature might call for a boost in pressure of 5 to 10 psig or only 1 to 2-in. w.c.

Each type of booster is designed to have a base pressure setting (where it will act as a convenient regulator), then, depending upon conditions, will boost above this base.

The most successful applications, of late, have been various combinations of each feature of the three types in a single unit. The time-temperature booster is a good example. In a system where peaks are generated because of non-temperature affected loads at certain times of the day, the timer is utilized. If, however, the system is also subjected to temperature affected load swings, then the "time boost" can be over-ridden by the temperature feature.

The closest approach to a computer is a regulator with a base pressure setting, a time booster to anticipate *known* swings in load, a temperature over-ride feature, and a velocity feature that would over-ride the others in the event that some loads, not foreseeable, began to affect the system.

Automatic compressor stations on supply mains may be used instead of laying new and larger mains. These can be made fully automatic or remotely controlled and used in the regulation of pressure drops, temperature, or time, or a combination of these.

Other Developments

Another new development that could come under automation is *seismic analysis*, a new technique for solving ditching problems. This method, which uses sound waves, is described in the February, 1960, issue of the AMERICAN GAS JOURNAL.

A good many companies are using telemetering to record the daily consumptions of their large industrial customers. We use this method on many of our customers.

Some companies have remote control devices for reading domestic meters on the outside. Some of the devices read the meters directly. Others use instruments and automatically record the readings on a tape to be fed into a computer when it is returned to the office. There has been some experimentation with Walkie-Talkie. A meter reader would read the meter over the Walkie-Talkie to a person at the office or even into a computer. A device to use a person's telephone has also been developed, where one dials and gets the meter reading.

Many more studies are being made of automatic equipment and in the next few years, automation will be firmly established in the gas distribution industry, paving the way for the improvement of our now perfect service by helping us to more fully utilize our present equipment, and to extend this service to all communities. * * *

New Methods of Generating Electricity From Gas Sources

2 — Thermionic Effects and Magnetohydrodynamics

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Thermionic Concepts
Thermionic Developments
Thermionic Applications
MHD Power Processes
MHD Performance Estimates
MHD Applications

THERMIONIC EFFECT

Concept and Problems

The concept of direct conversion of heat into electricity by thermionic emission was first suggested around 1915, but not much attention was given to the idea, principally because of the low efficiency of the process at that time. The main difficulties were

(1) improper design,

(2) lack of suitable electrode materials which would readily emit electrons and develop a reasonable voltage, and

(3) inability to overcome the space charge effect. Only within the last few years has appreciable progress been made to resolve some of these problems.

A thermionic converter may be looked upon as an "electron thermocouple" whose operation is analogous to that of a thermoelectric generator. A schematic is given in Fig. 7. A metal surface (shown as a plate), called the cathode, is heated until it emits electrons. They travel toward a second plate, the anode, which is kept at a relatively low temperature.

The emitted electrons, however, may meet considerable resistance in the gap between the two plates, due to the "space charge" effect (a cloud of electrons tends to repel other electrons), and when they reach the anode are at a higher voltage than the cathode. This voltage difference drives an electric current through an external circuit to do useful work. The thermionic converter is sealed against the atmosphere to prevent oxidation and maintain the system at low pressure, under which it operates at best efficiency.

Like the thermoelectric generator, a thermionic converter is basically a low-voltage, high-current device. Typically, a single-stage thermionic converter may develop 1 to 2-v at a current density of about 15 to 30 amp per sq in. of electrode surface, although higher values have been achieved.

The voltage-current characteristics largely depend upon the composition of the electrodes, their temperature, and the manner in which the space charge effect is overcome. Higher output voltages are obtained, of course, by connecting several thermionic stages in series. In comparison, a single-stage thermoelectric generator may develop typically about ¼-v. at a current density of about 10 to 20 amp per sq in. of heated surface.

Depending upon electrode composition, a thermionic converter operates at cathode temperatures in the range 1700 to 2400 F, and up to 3600 F with refractory materials. It is a high-temperature device as compared to present thermoelectric generators. With these high temperatures and the use of specially emissive electrode materials now under development,[16] the thermionic converter may attain efficiencies as high as 25%; thermoelectric generators, on the other hand, rarely achieve thermal efficiencies of 10%.

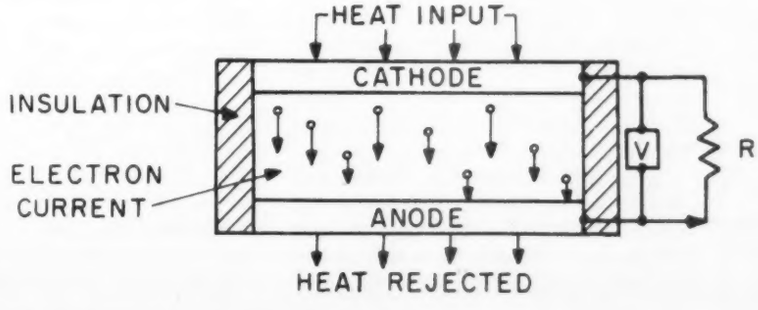

FIG. 7. Thermionic generator is shown in schematic diagram.

Factors that primarily determine the efficiency of thermionic conversion of heat into electricity are

(1) heat losses by radiation, conduction and convection from the cathode,

(2) the voltage difference between cathode and anode, and

(3) the current density or number of amperes per sq in. flowing between cathode and anode.

A maximum efficiency converter requires a maximum product of voltage and current (power), and minimum rate of heat loss. The temperature characteristics of thermionic converters is such that at first the electrical power increases more rapidly than heat losses as the cathode temperature is increased. With further increases in temperature, the radiant heat loss increase overshadows the electrical power increase, and thermal efficiency will have reached its maximum and start to decline.

In present thermionic converter development the attack on the problem of efficiency improvement has been directed along two major avenues:

(1) choice of proper electrode materials, and

(2) minimization of the space charge effect.

The latter has been achieved in part by extremely close spacing of the electrodes, or by introduction of positive ions between electrodes.[12,13,16,17,19,34]

Present Thermionic Converters and Potential Applications

Among the various groups engaged in thermionic research and development, a few of the noteworthy achievements appear to be:

(1) **Construction and testing of a novel "thermoelectron engine"** by Hatsopoulos and Kaye[14] of MIT, and further development of this engine by the Thermo Electron Engineering Corporation. The thermoelectron engine is a close-spaced vacuum diode constructed of two hollow cylinders, the flat bottom surfaces of which are placed back-to-back. These flat surfaces, separated by distances less than 1/1000-in., serve as cathode and anode.

The experimental engine was designed with electrical heating, although with modifications it could be heated radiantly from a gas source. The unit typically delivers about 0.5-v. and 10-amp per sq in. at 2300 F cathode, 1000 F anode, at about 12% thermal efficiency. The small separation of cathode and anode minimizes the space charge effect. Improved results are expected with still smaller electrode separations and better electrode materials.

(2) **Development of several thermionic converter prototypes** of 3 to 100 watts output for the Atomic Energy Commission.[2] This work is in progress, with the objective of fulfilling the need for small, long-lived and portable power sources in the U. S. Space Programs. The converters will utilize radioisotopes as the heat source. One 3-watt unit (SNAP-III-C), developed by the Thermo Electron Corporation, will use close-spaced electrodes of specially impregnated tungsten at 1800 F cathode and 1300 F anode temperatures, under which conditions the thermal efficiency is expected to be 6%.

Another 3-watt unit (SNAP-III-D), developed by United Electronics Company, employs specially coated nickel electrodes which are closely spaced by means of a porous insulating material. The highly emissive nickel electrodes will permit operation at cathode temperatures near 1300 F at about 5% thermal efficiency.

(3) **Development of the plasma thermocouple** at Los Alamos.[12,13] This device is a thermionic converter into which positive ions are introduced to overcome the space charge effect. The space between electrodes is filled with a mixture of flowing electrons and positive ions. This mixture is plasma, hence the designation "plasma thermocouple."

The unit was developed as a potentially new means for converting high-temperature nuclear energy directly into electricity. The cathode consisted of an alloy of zirconium carbide-uranium carbide, self-heating by fissioning of the uranium at temperatures up to 3600 F. In operation, liquid cesium is vaporized into the cell, and at sufficiently high temperature the cesium ionizes, forming positive charged ions. Thermal efficiencies in conversion of nuclear heat into electricity ranged from 5 to 15%.

Because thermionic converters are in the very early stages of development, it is unrealistic at this time to make predictions of their possible extent of use and application. This will depend upon the ultimate costs, efficiencies and durability.

Potentially, thermionic devices are capable of surpassing thermoelectric devices for direct conversion of heat without moving parts. It is safe to say that both types are presently applicable to small-scale uses where costs and efficiency are unimportant.

A gas-fired diode, the size of a radio tube, generating a few foolproof watts of power, appears a likely application for some control purposes. If thermionic converters should enjoy a large-scale development, we foresee potential applications as topping units in conventional and nuclear power plants.

A further possible method for improving direct conversion of high-temperature heat to electricity comprises the combination of a thermionic converter in series with a thermoelectric generator. This combined device has not yet been built, but its potentialities are promising. Here a portion of the heat would be converted at high temperature levels (say 2500 to 1000 F). The anode (cold plate) of the thermionic converter would serve as the hot junction of the thermoelectric generator, where an additional portion of the heat would be converted at lower temperature levels (say 1000 to 100 F). The efficiency of this system could be as high as 20% for small-scale power generation, on the basis of the present state of development of thermoelectric and thermionic materials.

ELECTRIC POWER VIA MAGNETOHYDRODYNAMICS

Definition of MHD Power Process

Application of magnetohydrodynamics (MHD) in electric power generation has been recently suggested as representing promise for

(1) reducing the size and number of plant equipment components, and

(2) increasing thermal efficiencies of power plants to a sensational level of 55% from the present best conventional levels of about 35 to 40%.[1,10]

Ten electric utilities are now sponsoring a joint effort with Avco Corporation to explore the possibilities of this new process. Avco has constructed a 10-kw laboratory model MHD unit that produced 55-v. d-c for a short time. Other companies engaged in this field include General Electric, Westinghouse, Republic Aviation Corporation, and Lockheed Aircraft Corporation.

The MHD process develops power by forcing, under pressure, a fast-moving stream of electrically conducting fluid, such as ionized gases, through a magnetic field (Fig. 8). Ionization requires temperatures in the range 3000 to preferably above 4000 F.

The essential difference between MHD and a turbogenerator is that, in the former, the electric current is induced in the working fluid itself, while in the latter the turbine drives copper wires through the generator field.

Under present concepts, the MHD generator comprises a high-temperature elongated nozzle which has within it two collector plates or electrodes to withdraw power. The electrodes are analogous to the brushes in a conventional generator. External to the nozzle are electric coils that produce a strong magnetic field across the flowing ionized gas.

The essential components of an independently operated MHD process (Fig. 8A) comprise

(1) **a motor-driven air compressor** to develop the pressure needed for flow through the system,

(2) **a heat exchanger** for recovery of large amounts of waste heat leaving the MHD nozzle,

(3) **a pressure burner** yielding ionized combustion products,

(4) **a convergent-elongated divergent-type nozzle** to develop the high gas velocities (critical flow) needed for effective power generation in the magnetic field, and

(5) **electrical connections** to the elongated divergent section of the MHD nozzle.

Compared with a conventional plant, the MHD

(a) replaces a boiler plant with a pressure fuel burner plus a high-temperature gas-to-gas heat exchanger, and

(b) replaces feed water pumps and turbogenerator with a motor-driven air compressor and high-temperature flow nozzle.

With these components only, however, the MHD process is somewhat lacking in efficiency, due to unconverted energy in the form of kinetic energy of the high velocity effluent gases. In extreme cases, the effluent kinetic energy represents as much as 12% of the energy entering the nozzle. It does not appear feasible to convert much of this kinetic energy in the MHD unit, because of the excessive nozzle lengths needed.

Some advantage in efficiency is gained by providing an additional short divergent nozzle with no magnetic field (as an extension of the MHD nozzle), for kinetic energy recovery, thereby increasing the pressure and temperature of the effluent gas for improved heat exchange.

Operation of the MHD process in Fig. 8A in the most efficient manner requires also a final recovery of energy via expansion (after heat exchange), through a turbine, of the effluent gas pressure gained from kinetic energy recovery. The expansion turbine could provide up to 35% of the power for air compression.

An alternative arrangement comprises the MHD process as a topping unit for a conventional plant (Fig. 8B). The conventional plant would supply air compression, and produce some net power. This combination appears potentially more attractive, as it could result in

(1) a substantial decrease of the closeness of temperature approach in heat exchange needed in the MHD step,

(2) a moderate increase from conventional levels in overall plant efficiency, and

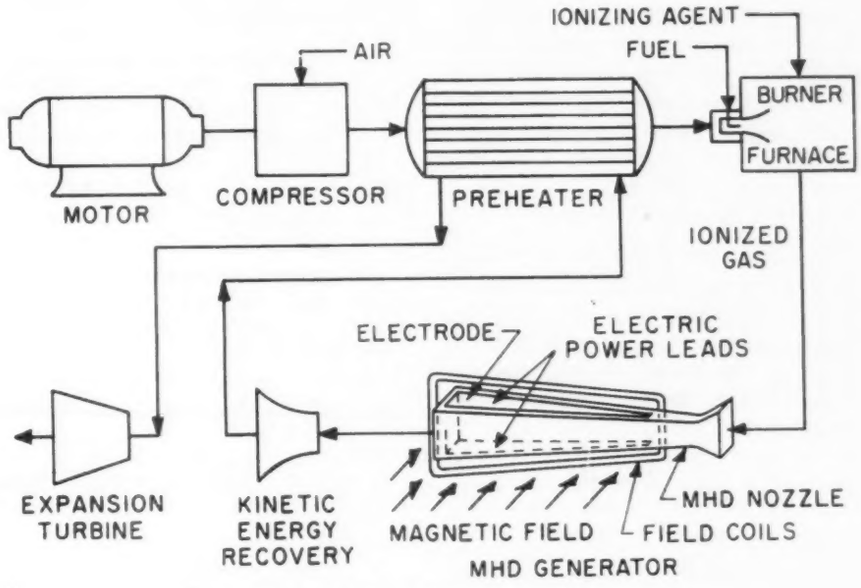

FIG. 8-A. Process schematic of an independent MHD unit.

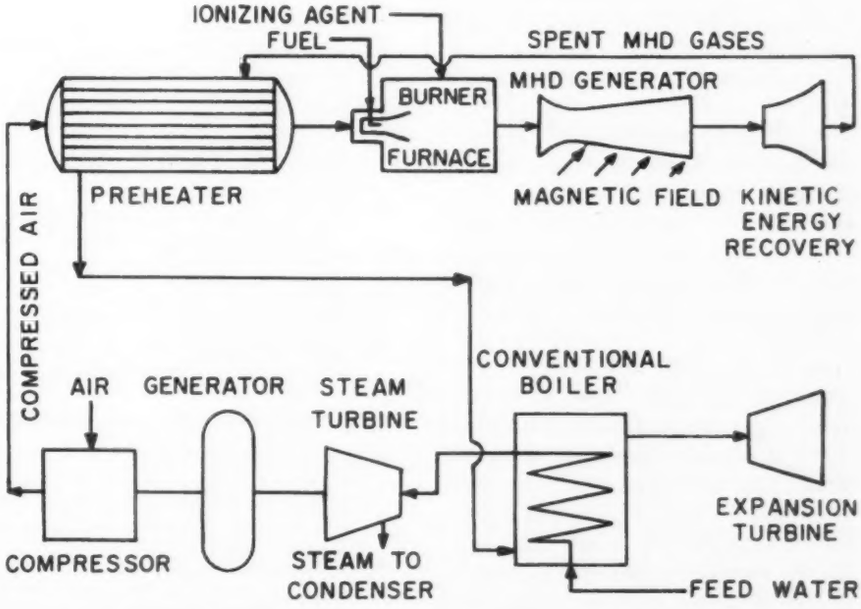

FIG. 8-B. Process schematic of an MHD-topped conventional electric generating plant.

(3) a moderate reduction in plant size for a given capacity.

The increase in efficiency results from the fact that the MHD unit would convert a portion of the incoming energy at high efficiency, while the conventional boiler can utilize 80 to 90% of the heat content of MHD effluent gases.

MHD Performance Estimates

In the MHD nozzle the voltage, V, developed in the flowing gas is directly proportional to the gas velocity, v_g, magnetic flux density, B, and electrode spacing, D. The voltage actually delivered, V_L, to an external load is less than the voltage generated in the gas, by a proportionality factor, $m/(1+m)$, where m is the ratio of external load resistance to internal resistance of the MHD unit. In equation form, we can write:

$$V = v_g BD$$
$$\text{and } V_L = v_g BDm/(1+m)$$

The total electric current, I, flowing in the MHD unit is directly proportional to the electrode area, A, the gas electrical conductivity, k_e, gas velocity, v_g, magnetic flux density, B, and is diminished by the factor $1/(1+m)$. In equation form we have:

$$I = \frac{Ak_e v_g B}{(1+m)^2}$$

Since the power to load, P_L, is given by the product of load voltage and current, then by multiplication we have:

$$P_L = \frac{k_e v_g^2 B^2 m}{(1+m)^2}$$

where P_L = power to load per unit nozzle volume.

In calculations with these equations, consistent units must be used. If P_L is in watts/cu meter, then k_e = mhos/meter, B = webers/sq meter (1 weber/sq meter = 10,000 gauss) and v_g = meters/sec. We see the importance here of having high gas velocities and high magnetic field strengths, since power increases with the square of these variables.

As a practical consideration, gas conductivities in the range 50 to 100 mhos/meter appear achievable with the aid of ionizing agents at high temperatures. The maximum practical magnetic flux is about 10,000 gauss. For conversion efficiency in the MHD nozzle, the ratio m in the above equations should be about 10.0; otherwise, too much power would be wasted by internal resistance. Under the best conditions, MHD power densities could be of the order of 200-kw per cu ft nozzle volume.

The performance of an MHD power process was estimated by solving simplified versions of the MHD equations[3,29] and making energy balances for the system. Some of the results are given here.

It was found that the best theoretical efficiency of the system in Fig. 8A is 44% without the expansion turbine, and 51% with the expansion turbine, at convergent nozzle inlet conditions of 4500 F and 10 atm, no fluid friction in the MHD nozzle, and other conditions as listed:

(1) Critical flow through nozzle at 3060 ft per sec, 5.8 atm, and 4140 F at the throat,

(2) Expansion to atmospheric pressure and 3140 F at a constant velocity of 3060 ft per sec in the MHD section of the nozzle,

(3) 10 to 1 ratio of load resistance to internal resistance of the MHD unit,

(4) Magnetic flux density of 10,000 gauss and gas conductivity of 100 mho per meter,

(5) 97% flow efficiency of the convergent nozzle,

(6) Kinetic energy recovery at 90% hydraulic efficiency, yielding effluent gas heat exchange inlet conditions of 3600 F and 2.0 atm,

(7) Air preheat within 100 F of the effluent gas heat exchange inlet temperature, with no other heat losses and 5 psi drop through each side of the exchanger,

(8) Two-stage air compression to 10.35 atm at 90% hydraulic efficiency and 90% motor efficiency, and

(9) Expansion-turbine energy recovery at 90% hydraulic efficiency.

The air compression requirements represent about 38 % of the net electric power. A nozzle of 1.0 sq ft area at the throat, tapering to 4.4 sq ft at the outlet (350 cu ft volume), produces an estimated 70,000 kilowatts to load. The nozzle is estimated to be 187 ft long at 10,000 gauss and 100 mho per meter gas conductivity, and generates about 22-v to load per inch of

TABLE 1. — MHD Process Estimate for Frictionless Nozzle and No Heat Losses.

PRINCIPAL CONDITIONS	Case I	Case II
Entering Nozzle Pressure, atm	10	30
Nozzle Throat Pressure, atm	5.8	17.3
Entering Nozzle Temp, F	4500	5040
Nozzle Throat Temp, F	4140	4675
MHD Nozzle Velocity, ft/sec	3060	3290
Nozzle Outlet Pressure, atm	1.0	1.0
Nozzle Outlet Temp, F	3140	3170
Pressure after Kinetic Energy Recovery, atm	1.95	2.2
Temperature after Kinetic Energy Recovery, F	3600	3610
Magnetic Flux Density, gauss	10,000	10,000
Gas Conductivity, mho/meter	100	100
Resistance Ratio, load/internal	10	10
A. INDEPENDENT MHD UNIT		
Preheated Air Temp, F	3500	3510
Fuel/Air Ratio, stoichiometric %	60	98.5
Load Power per sq ft Nozzle Throat, mw	70.2	364
Load Power Density, kw/cu ft nozzle	203	235
Nozzle Length, ft	187	594
Spent MHD Gas Temp after Heat Exchange, F	1160	1450
Air Compression, % of net power	38	25
MHD Efficiency without Expansion Turbine, %	44.4	52.8
MHD Efficiency with Expansion Turbine, %	51.3	59.2
B. MHD-TOPPED CONVENTIONAL PLANT		
Preheated Air Temp, F	1900	3460
Fuel/Air Ratio, stoichiometric %	100	100
Load Power per sq ft Nozzle Throat, mw	70.2	364
Load Power Density, kw/cu ft nozzle	203	235
Nozzle Length, ft	187	594
Spent MHD Gas Temp after Heat Exchange, F	2520	1520
Air Compression, % of net power	17	20
MHD Efficiency without Expansion Turbine, %	51.6	64.7
MHD Efficiency with Expansion Turbine, %	53.9	67.2

electrode spacing. Other details of these results are given in Table 1, Case I.

It must be pointed out that the 44 and 51% MHD efficiencies estimated above, as well as other efficiencies to be discussed subsequently, probably cannot be achieved under the stated conditions, since the calculations did not consider MHD eddy current losses, radiation and convection heat losses from the exchanger and nozzle, the energy required to maintain the magnetic field, and fluid friction losses in the MHD nozzle. Fluid friction in an elongated nozzle can substantially decrease efficiency, since gas pressure is the driving force which controls the amount of energy directly converted in the magnetic field.

Estimates for an MHD-topped conventional plant (Fig. 8B and Table 1, Case I), operated at the MHD conditions stated above, and in which 35% conventional plant efficiency is assumed, indicate that

(1) 27% of the heat added to ionized gases is directly converted in the MHD unit, and

(2) the combined theoretical efficiency, after allowance for air compression, approaches

(a) 52% without the expansion turbine, and

(b) 54% with kinetic energy recovery as expansion turbine work.

Without the expansion turbine, the MHD unit directly generates about

(1) 54% of net power if compression requirements are deducted from MHD, or

(2) 71% of net power if compression requirements are deducted from the conventional plant output.

The portion of energy topped by MHD (between 4140 to 3140 F, Table 1, Case I), is converted at 76 and 82% theoretical efficiency without and with the expansion turbine, respectively, not taking into account, however, the MHD heat, eddy current, field coil, and nozzle fluid friction losses.

Theoretical MHD efficiencies can be improved by an increase in the nozzle inlet pressure-temperature conditions. This effect is demonstrated in Table 1, Case II, for 5040 F, 30 atm nozzle inlet, with no fluid friction in the MHD nozzle, and other applicable conditions remaining the same.

In this case the ionized gases are estimated to enter the magnetic field at 3290 ft per sec, 17.3 atm, and 4675 F, and leave at 3290 ft per sec, 1.0 atm and 3170 F. A nozzle about 595 ft long is needed at 10,000 gauss and 100 mho per meter gas conductivity.

Here the nozzle, if of 1.0 sq ft area at the throat, tapers to 12.2 sq ft at the outlet (1550 cu ft volume), and generates an estimated 364,000 kw to load at 23-v per inch of electrode spacing. Air compression (3-stage) requires about 25% of the net generated power.

The theoretical efficiency of the independent MHD process (Fig. 8A), approaches 53% without the expansion turbine, and 59% with it.

In the MHD-topped conventional plant (Fig. 8B), the MHD unit directly generates about 80% of the net power if compression is deducted from the MHD, and the theoretical overall efficiency is about 64% without the expansion of turbine, and 67% with it (Table 1, Case II).

Sources of losses already mentioned will significantly decrease these efficiencies. In particular, inability to maintain an average ratio of external to internal resistance at the 10.0 value selected here will cause increased ohmic losses. Fluid friction may become significant in small-diameter and long nozzles. An estimate of the latter effect was made for a 1.0 sq ft throat area nozzle operated under the conditions specified for Cases I and II, Table 1.

On the basis of a 0.0027 friction factor, which is typical of 12 to 18-in. diam pipe (the nozzle is assumed to be at least as smooth as a pipeline), these results indicate for Case I with friction:

(1) MHD nozzle outlet temperature increased from the previous 3140 F to 3380 F.

(2) Nozzle length decreased from the previous 187 to 100 ft, estimated volume decreased from 350 to 275 cu ft, and load power decreased from 70,000 to to 56,000 kw,

(3) Efficiency of an independently operated unit decreased to 32% without the expansion turbine, and to 40% with it, and

(4) Efficiency of an MHD-topped conventional plant decreased to 46% without the expansion turbine, and to 48% with it.

The estimates for Case II with friction are:

(1) MHD nozzle outlet temperature increased from the previous 3170 to 3500 F,

(2) Nozzle length decreased from 595 to 173 ft, volume decreased from 1550 to 1245 cu ft, and load power decreased from 364,000 to 292,000 kw,

(3) Efficiency of independently operated MHD unit decreased to 41% without the expansion turbine and to 49% with it, and

(4) Efficiency of the MHD-topped plant decreased to 55% without the expansion turbine, and to 57% with it.

Evaluation of MHD Processes

The high-temperature MHD process appears to hold promise for significantly increasing the efficiency of conventional plants by topping — if suitable construction materials can be developed, and if thermal and other sources of losses can be minimized.

The process is not as promising when operated as an independent unit because of the large amounts of heat that must be recycled through heat exchange to maintain efficiency. The prime factors that must be achieved are extremely high magnetic field strengths, high gas conductivities, high gas flow velocities, and minimum frictional pressure losses.

These factors are conducive to a high magnetohydrodynamic pressure drop, which directly controls the fraction of heat energy converted to electrical energy, and which minimizes the nozzle length.

With arbitrarily short nozzles and small pressure drops, the MHD process cannot approach the efficiency of conventional plants. In the cases estimated here, the fraction of energy added to the ionized gases that is directly converted in the MHD process is

(1) 27% without fluid friction, and 21% with fluid friction, at 10 atm and 4500 F gas entering the convergent nozzle section, and

(2) 38% without fluid friction, and 30% with fluid friction, at 30 atm and 5040 F gas entering the nozzle.

In comparison, the conventional power plant converts to mechanical energy upward of 40% of the energy added to steam at 2000 psi and 1000 to 1100 F, and requires only moderate heat recycle for water preheat and flue gas recuperation.

The largest saving in MHD over a coal-fired plant appears to be elimination of feedwater pumps and coal handling equipment (if MHD is not coal-fired), or, if an MHD-topped plant is

to be considered, the largest potential saving is reduction in plant size for a given electrical capability. In the topped plant the generated current comprises normal-voltage a-c and low-voltage d-c.

Development of a practical MHD process poses many problems in high temperature technology that await solution.

These include:

(1) **Heat-exchange materials** capable of withstanding 5 to 10 atm or more pressure differential at temperatures up to 3000 F, and

(2) **Nozzle and electrode materials** for temperatures exceeding 4000 F.

A basic problem comprises methods for increasing the electrical conductivity of ionized gases. Areas of investigation have included:

(1) addition of materials such as potassium, and possibly sodium and cesium which readily ionize at high temperatures and

(2) production of shock waves in the gas.

Alternatives for improved gas conductivity may be:

(1) use of atomic radiation in the MHD nozzle, and

(2) direct application of MHD to a gas or oil combustion flame.

Summary

The MHD process falls in the category with thermoelectric and thermionic generators and fuel cells as potential devices for direct conversion of thermal and chemical energy to electricity.

Because of the high temperatures and lengths of nozzle required for effective conversion, MHD units appear more suited for gas and oil-fired central stations of the 100-megawatt class.

Thermoelectric devices, which do not require high temperatures, and low-temperature fuel cells, are less complex in amount of equipment, simpler to operate, and are undoubtedly more flexible in respect to size of application, particularly for small to intermediate-scale use.

Thermionic devices, which require temperatures intermediate of thermoelectric and MHD, appear potentially suited as topping units for conventional and nuclear plants. In respect to potential efficiencies, fuel cells are highest, followed in turn by MHD, thermionic, and thermoelectric processes.

Acknowledgment

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AQUIFERS for Underground Natural Gas Storage

5 | Water well stimulation, performance evaluation, tracers

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Water Well Stimulation

Although there is a similarity between the technology of crude-oil production and the technology of ground-water production, there is a great lack of effective communication between the personnel of the oil industry and the personnel of the water-well industry.

The general correlation is related to the fact that both industries deal with the flow of fluids in porous subsurface media and the laws of physics governing the flow of fluids are basically identical.

Moreover, the drilling methods employed in drilling wells for water and for crude oil are basically similar. Therefore, one would normally look for a wide exchange of long standing in the basic technological developments developed by operating personnel and engineers in both industries.

Strikingly, not only is there a hiatus in communication between these personnel but basically there is not a *standardized nomenclature* correlatable between these two engineering groups. Only in recent months has the application of underground aquifers for natural-gas storage operations brought out the need for an understanding by the natural-gas engineer for a refresher of hydraulic principles as well as familiarity by the water-supply engineer for the problems of natural-gas production and underground storage.

Stimulation has been defined as treatment of a well by *mechanical, chemical or other means for the purpose of reducing or removing an underground resistance to flow.* It is confined to treatment of an existing well, not its reconstruction.

Stimulation Nomenclature

The water supply field does not employ a comprehensive term which would connote all that is meant by stimulation. Comparable terms used in the water-supply field are *development, redevelopment, rehabilitation,* or *reconditioning.*

EDITOR'S NOTE: This installment is the fifth and concluding part in a series of five engineering articles on "Underground Natural Gas Storage in Aquifers" that has been presented each month as part of AGJ's continuing educational-refresher series on natural gas and gas distribution operations.

Prior installments covered the following aspects: (1) Need for gas storage, types of storage and case histories of aquifers; (2) Criteria for selection of aquifers, geology, lithology, and economics; (3) Lease rights acquisition, the drilling contract, well spacing, drilling, logging and completion of input, output, and service facility wells; and (4) Reservoir performance calculations, drawdown and buildup curves.

This installment covers analysis of performance data for various types of stimulation of individual water wells, and the use of tracers in remedial operations.

Development. This term usually means some treatment which is applied upon completion of the well.

Redevelopment. This term refers to treatment applied at a time subsequent to that time when a well has declined in productivity.

Rehabilitation. This term, together with the term *reconditioning,* not only suggests a treatment after completion of the well, but they may mean complete removal and replacement of the casing or screen, enlarging the well bore, or drilling the well deeper into the same sand or into a deeper aquifer. However, these operations are not included in the definition of stimulation which is limited to well treatment of an existing well, generally at the time of its original completion.

Therefore, the term *stimulation,* would not include workover operations, in the parlance of the oil industry usage, for the purpose of clearing up turbidity, sand, sediment or other impurities which may have been introduced into the well during the course of drilling operations.

Stimulation Methods

Koenig (1960) has studied the technical performance factors in water well stimulation drawn from 870 actual stimulation cases in 141 counties situated in 24 states of the United States.

Breakdown of 483 wells that provided data used in the table below are:

TABLE 1 — Analysis of Wells by Use, Aquifer Lithology and Well Treatment

Category	Percent of total wells
Use	
Brine production	3.7%
Salt water disposal	3.7%
Waterflood injection	8.9%
Waterflood makeup water	0.2%
Industrial (nonpotable)	12.4%
Irrigation	12.0%
Potable	51.9%
Unknown	7.2%
Aquifer lithology	
Consolidated (undifferentiated)	6.4%
Consolidated limestone	15.4%
Consolidated sandstone	38.4%
Unconsolidated	37.6%
Unknown	12.2%
Well treatment	
Hydraulic fracturing	9.5%
Pressure acidizing	29.8%
Shooting	27.2%
Surging	13.9%
Vibratory explosion	10.6%
Unknown	9.0%

Summary of Results

From the 483 sources providing usable data, Koenig constructed cumulative frequency distribution curves for three criteria of performance evaluation:

1. Ratio of specific capacities immediately after (A), and immediately before treatment, (B). This measure of performance (A/B) is termed the *improvement ratio.*

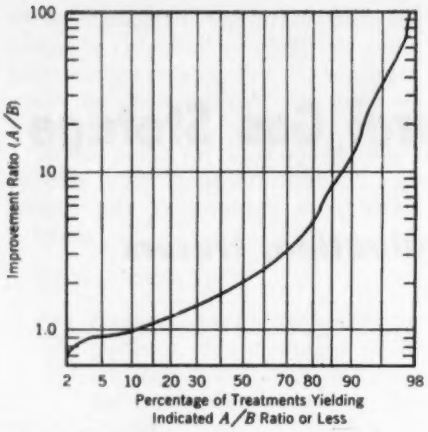

Fig. 1. Cumulative frequency distribution of improved ratios of 455 treatments of water wells in the U. S. arranged in order of ascending magnitude. Overall median improvement ratio was 1.97; for best 10%, 11.9; 11% had an improvement ratio of less than 1.0 indicating no improvement.

Fig. 1-5 after Louis Koenig, Jour., A.W.W.A., Vol. 52, No. 3, March, 1960, pp. 333-350.

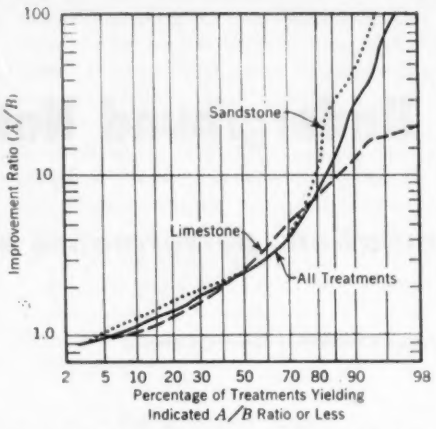

Fig. 2. Stimulation evaluation for two types of consolidated aquifers. Median improvement ratios: sandstone, (dotted curve) 166 treatments, 2.40; limestone, (dashed curve) 66 treatments, 2.50; and all 259 treatments, (solid curve) 2.41.

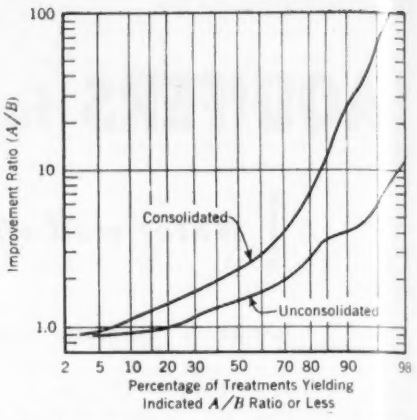

Fig. 3. Performance evaluation for stimulation in consolidated and unconsolidated aquifers, 259 treatments, 7% failures, 2.41; unconsolidated aquifers, 130 treatments, 20% failures, 1.45.

2. Ratio of specific capacities immediately after treatment (A) and immediately before treatment (O). This measurement of performance (A/O) is also termed an *improvement ratio.*

3. Ratio of the increment in specific capacity as a result of treatment (I) to the specific capacity of the original well (O).

Evaluation of these various stimulation techniques is shown in Table 2, for both A/B and the A/O criteria.

For all types of treatments in all types of formations, the median ratio indicated a 97% improvement over specific capacity immediately before treatment, and a 20% improvement over the original production of the well.

Failures to achieve any improvement over the treated well were 11%, whereas failures to bring about improvement over the original well were 43%.

The median increment of specific capacity brought about by treatment was 43% of the specific capacity of the original well.

Greater success has been obtained in consolidated formations than in unconsolidated formations. Consolidated formations showed a median of 141% improvement whereas unconsolidated formations showed only 45% improvement.

Ground-Water Tracers

Problem Background. For the past half century, the measurement of velocity and the direction of fluid flow through porous media have been of major interest to the hydrologist, soil mechanic expert, petroleum engineer, sanitary engineer, and others engaged in related fields, both in the laboratory and in the field.

The entire study has followed the paths of mathematical theory which were validated in the laboratory, with the assistance of potentiometric models, and later verified in pilot-plant projects in actual field practice, followed by full plant procedures.

One of the first techniques accepted by the engineering profession for estimation of underflow was the basic work of Slichter (1905), who employed solutions of various salts and measured the time of tracer-front arrival by changes in resistivity of ground water at electrodes placed in observation water wells.

In recent years, use of injection wells by the oil industry for flooding depleted oil reservoirs as a means of increasing recovery has stimulated interest in tracing the underground movement of recharged fluids.

Restrictions placed by state regulatory agencies on the discharge of produced formation water into underground aquifers suitable as domestic water sources has further stimulated the need for more reliable methods of determination of the movement of fluids through soil voids. Most recent stimulus for this subject is the selection of a safe and economical underground disposal method for radio-

TABLE 2

Evaluation of Various Stimulation Techniques of Water Wells by Several Criteria

Data: Koenig, Louis, "Survey and Analysis of Well Stimulation Performance," Jour. A. W. W. A., Vol. 52, No. 3, March, 1960, pp. 333-350.

Stimulation method	A/B Criterion Performance[1]			A/O Criterion Performance[2]		
	Median value	Median value (best 10%)	Failures percent	Median value	Median value (best 10%)	Failures percent
Surging	1.20	3.4	24.0	0.66	2.5	75.0
Shooting	2.12	8.2	0.5	1.50	4.6	32.0
Vibratory explosion	2.25	7.6	0	0.61	1.5	61.0
Pressure acidizing	2.61	16.1	13.0	1.96	8.1	29.0
Fracturing	5.00	60.0	13.0	13.00	51.0	6.0
All methods	1.97	11.9	11.0	1.20	8.9	43.0

1A/B, termed the "improvement ratio," i.e. the ratio between the specific capacity immediately after treatment A, to the specific capacity immediately before treatment B.
2A/O, termed an improvement ratio, i.e. the ratio of specific capacities immediately after treatment, A, to the specific capacity at the time of constructing the original well O.

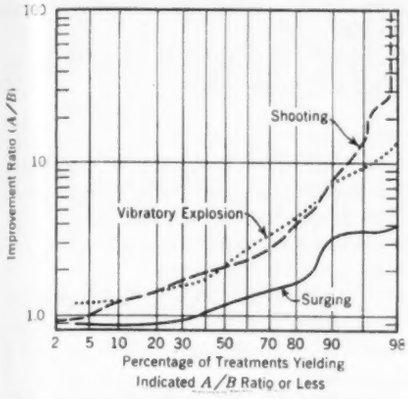

Fig. 4. Performance evaluation for vibrating explosion, shooting and surging treatments. Median improvement ratios: vibrating explosion, 51 treatments, 2.22; shooting, 120 treatments, 2.21; and surging, 79 treatments, 1.20.

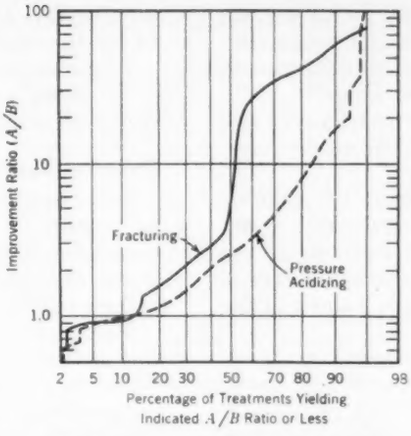

Fig. 5. Performance evaluation for pressure acidizing and fracturing treatments. Median improvement ratios: pressure acidizing, 133 treatments, 2.61; fracturing, 40 treatments, 5.00; failures for each method, 13%.

active wastes of a fast-developing nuclear power industry, and the permanent storage of long-lived products of fission in connate water-bearing strata has been seriously suggested as a possible solution to this impending problem.

Ideal Conditions. The ideal ground-water tracer should depict correctly the velocity variations of the liquid being traced without modifying in any way the inherent transmission characteristics of the liquid-porous medium system.

Another requirement is that the tracer be detectable in low concentrations in order to minimize changes in structure of the medium or liquid properties that might modify the permeability.

Still another requisite is that the tracer should not be retained on the solid phase by ion exchange or adsorption, because this in turn causes a retardation of the tracer front.

Front Dispersion Factors. Kaufman and Orlob state that the major velocity variation that occurs during the movement of fluids through a complex system of voids in naturally formed porous strata is particularly dependent on the *anisotropic and heterogeneous character of the medium.*

While it is often possible to estimate a mean frontal velocity for Darcy's law and the porosity of the medium, it is readily apparent by inspection of a typical tracer breakthrough curve that *all portions of the front do not move at the same velocity.*

The degree of front dispersion or dilution along the axis of flow may be considered to be a function of several individual phenomena (neglecting any interaction between tracer component and the porous medium) as follows:

1. *Permeability Effects:* Gross or macroscopic variations in permeability may result in channeling, or 'fingering,' which results in accelerated travel of portions of the tracer front, while other portions of the front may be retarded. The movement of such fingering may be either *longitudinal* or *transverse* to the major direction of flow.

2. *Velocity Variations:* Velocity differences from pore to pore, may also be caused by minute variations in permeability resulting from not only variation in diameters of adjacent pores, but in the *pore-size distribution,* which will increase the length of the front.

3. *Capillary Effects:* Velocity distribution within a single capillary may bring about additional longitudinal dispersion with additional lengthening of the front.

4. *Molecular Diffusion:* The existence of molecular diffusion in the direction of flow is of relatively small significance except in those cases where the actual linear flow rate is very small. However, diffusion *transverse* to the rate of flow may become a significant factor in determination of frontal characteristics.

Helium as a Tracer. Experimental laboratory data pre-

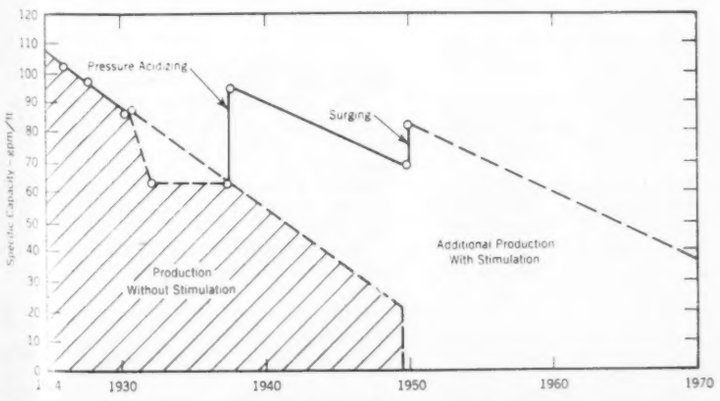

Fig. 6. Effect of pressure acidizing and surging stimulation operations on the performance of an individual well is indicated in the above figure. The application of stimulation to this well nearly doubled its ultimate water production and more than doubled its productive life.

(Courtesy A.W.W.A.)

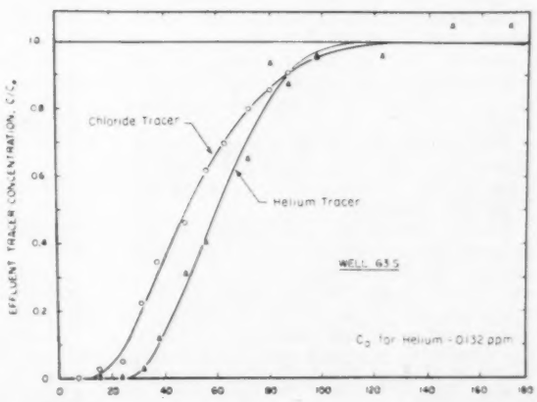

Fig. 7. Breakthrough curves for normalized helium and chloride tracers at a 63-ft observation well.

(After Carter, Kaufman, Orlob, and Todd, Journ. Geophys. Res. Vol. 64, No. 12, Dec. 1959.)

pared by Carter, Kaufman, Orlob, and Todd (1959) indicate that helium is a feasible ground-water tracer through confined aquifers such as those employed in underground natural-gas storage projects, i.e. anticlines, domes.

Helium exhibits advantages of being inexpensive, safe to handle, relatively easy to measure, is chemically inert, and requires only minute concentrations.

The helium curve in Fig. 7 lags behind the chloride curve by 17.0%; this difference may be attributed to the adsorption of helium on the fine-grained materials of the aquifer. The different slopes of the breakthrough curves in Fig. 7, if they may be considered significant, suggest different dispersion rates.

If, however, dispersion is treated as a property of a given porous medium, then the deviation of the helium curve from the chloride curve can be attributed to a variation in the rate of helium addition or to a rate-limiting sorption phenomenon.

Effect of Entrapped Gases

Orlob and Radhakrishna (1958) through laboratory experiments have proved that comparatively minor modifications in the geometry of a porous medium by inclusion of a *static gaseous phase* can produce significant changes in the hydraulic characteristics of the medium.

A 10% accumulation of air in media void spaces may produce as much as 15% reduction in effective porosity of comparatively uniform materials used in the laboratory experiments. Thus gas entrapment could be an important factor in determination of the potential capacity of an underground water supply.

Moreover, gas entrapment can drastically alter the shape of the dispersion or 'breakthrough' curve.

Tracers Correlated

Laboratory studies indicate that no tracer is completely satisfactory for every situation. Because each tracer has its limitations, it should not be used without a full understanding of the conditions imposed by both the carrying liquid and the medium through which it must pass.

The use of cationic materials, which include radio-isotopes and certain organic dyes, have generally proved to be unsatisfactory in any situation involving porous media with a measurable exchange capacity.

Similarly, anionic radio-isotopes, when used in a carrier-free form, will be largely retained by adsorption.

The susceptibility of dextrose to decomposition by soil micro-organisms seriously limits its use as a ground-water tracer.

Tritium, when used as tritiated water, has its limitations, in that it may exchange with soil-bound water with a resulting reduction in velocity of the tracer front.

Chloride, however, may be used with good results where density effects can be avoided, and under conditions where clay dispersion conditions are not of sufficient magnitude to seriously affect results.

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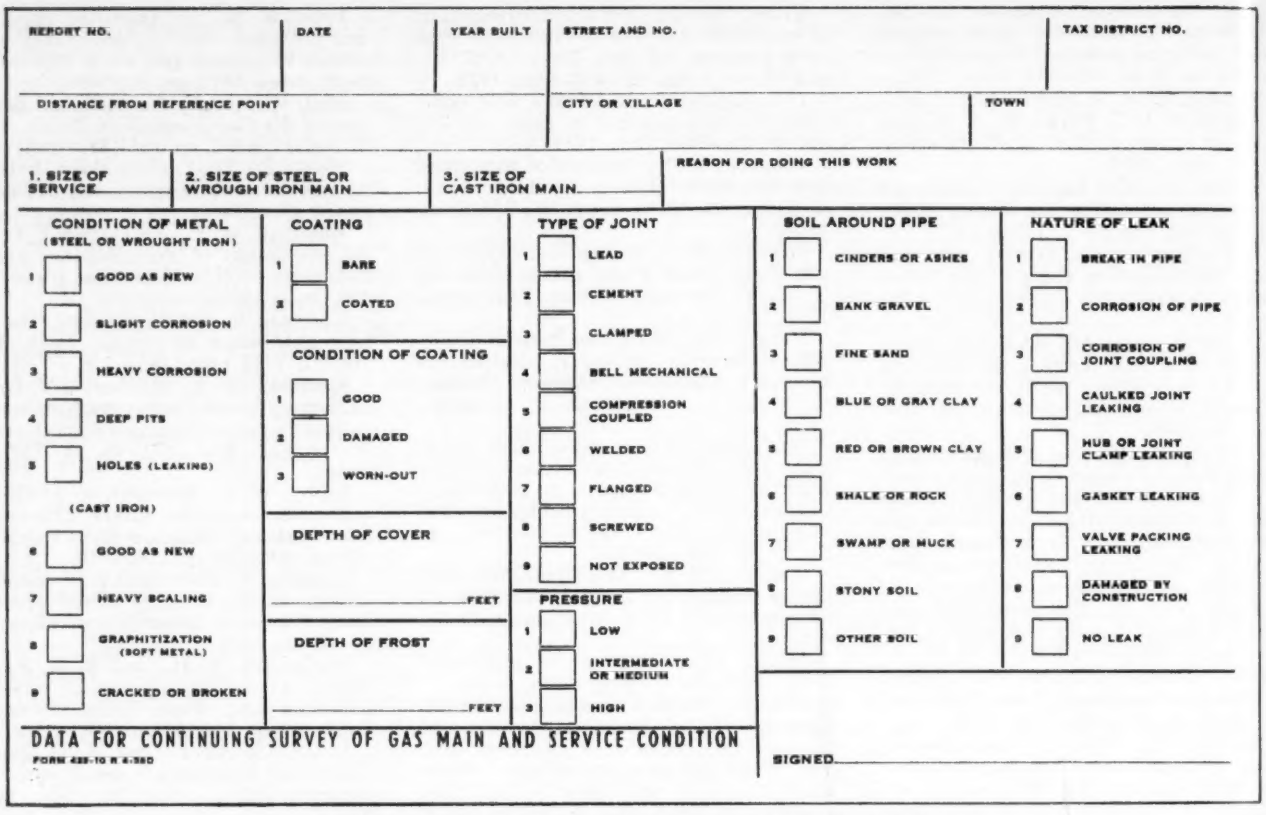


REPORT NO. | DATE | YEAR BUILT | STREET AND NO. | TAX DISTRICT NO.

DISTANCE FROM REFERENCE POINT | CITY OR VILLAGE | TOWN

1. SIZE OF SERVICE | 2. SIZE OF STEEL OR WROUGH IRON MAIN | 3. SIZE OF CAST IRON MAIN | REASON FOR DOING THIS WORK

CONDITION OF METAL (STEEL OR WROUGHT IRON)
1 GOOD AS NEW
2 SLIGHT CORROSION
3 HEAVY CORROSION
4 DEEP PITS
5 HOLES (LEAKING)
(CAST IRON)
6 GOOD AS NEW
7 HEAVY SCALING
8 GRAPHITIZATION (SOFT METAL)
9 CRACKED OR BROKEN

COATING
1 BARE
2 COATED

CONDITION OF COATING
1 GOOD
2 DAMAGED
3 WORN-OUT

DEPTH OF COVER
_____ FEET

DEPTH OF FROST
_____ FEET

TYPE OF JOINT
1 LEAD
2 CEMENT
3 CLAMPED
4 BELL MECHANICAL
5 COMPRESSION COUPLED
6 WELDED
7 FLANGED
8 SCREWED
9 NOT EXPOSED

PRESSURE
1 LOW
2 INTERMEDIATE OR MEDIUM
3 HIGH

SOIL AROUND PIPE
1 CINDERS OR ASHES
2 BANK GRAVEL
3 FINE SAND
4 BLUE OR GRAY CLAY
5 RED OR BROWN CLAY
6 SHALE OR ROCK
7 SWAMP OR MUCK
8 STONY SOIL
9 OTHER SOIL

NATURE OF LEAK
1 BREAK IN PIPE
2 CORROSION OF PIPE
3 CORROSION OF JOINT COUPLING
4 CAULKED JOINT LEAKING
5 HUB OR JOINT CLAMP LEAKING
6 GASKET LEAKING
7 VALVE PACKING LEAKING
8 DAMAGED BY CONSTRUCTION
9 NO LEAK

DATA FOR CONTINUING SURVEY OF GAS MAIN AND SERVICE CONDITION
FORM 425-10 R 4-580

SIGNED _____

Inspection card is used to record observed conditions of buried pipes examined for possible leaks or otherwise uncovered by gas street crews.

Top Management Will Look At Corrosion Control

Niagara Mohawk study of corrosion of gas services — related to age of services, reported leaks, and soil types — reveals interesting data of type that will help management in making decisions on corrosion mitigation, replacements, etc.

R. M. SHEPARD, *Niagara Mohawk Power Corporation, Syracuse, New York*

THE CORROSION ENGINEER, particularly in a combination gas and electric company, seems to feel that top management does not appreciate his problems and is deaf to his dire prophecies. But all management by nature and training is extremely sensitive to any reporting of current performance.

Our company has accumulated a vast amount of raw data on current conditions in our buried gas plant, waiting only to be organized and interpreted to make fascinating management reading. This discussion is a partial report on our analysis of the first usable batch of data that we have received. Result from these interpretations has been an increased executive understanding of the problems arising from corrosion. With that understanding has come an increased willingness to make major appropriations for replacement of deteriorated facilities.

What contribution this discussion may make will be, not in any advancement of corrosion theory, but rather in a demonstration of the application of simple statistical techniques to the interpretation of a great mass of rudimentary field data.

Data Collection

Niagara-Mohawk, together with other New York state gas companies, requires gas street crews to report on the condition of buried facilities whenever they have occasion, in the course of their work, to uncover them. Observed conditions of the buried pipes are recorded on a card form, so designed that tabulating cards can readily be punched from it. A good deal of effort has been expended in training field personnel in recording their observations in such a manner and with sufficient completeness that the information obtained can be considered reasonably reliable.

In April 1959, approximately 13,000 main and service inspection cards, covering an 11-month period from May 1, 1958, to March 31, 1959, were called in and tabulating cards were punched from them. Various runs and counts

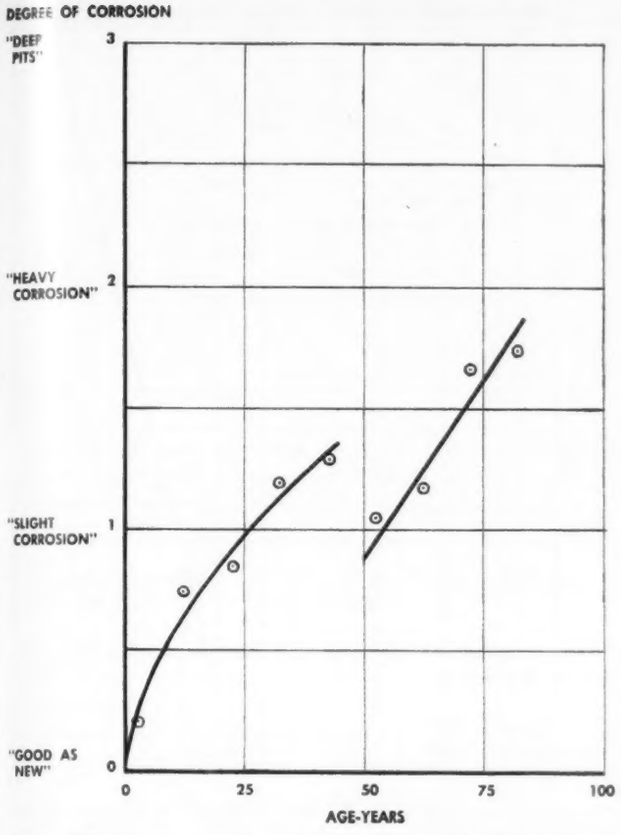


FIG. 1. **Observed corrosion of gas services of various ages.** Plotted points are average values for 10-year age groups.

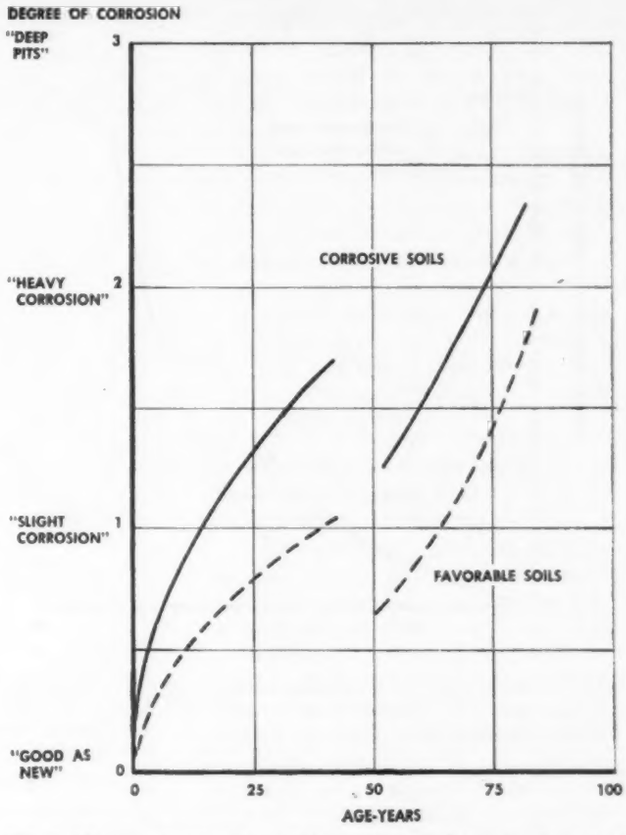


FIG. 2. **Observed corrosion of bare gas services,** showing effect of type of soil on apparent corrosion.

were made to develop usable summaries.

Service Laterals

In the 11-month sample, there were 4500 inspections reported on services that were not leaking and over 1000 reports on leaking services. Conditions of metal in the case of the first group and nature of leak for the second were correlated with type of soil, area, tax district, type of coating, pressure, etc.

The breakdown by nature of leak is as follows:

Broken pipe or fittings	132
Corrosion of pipe	822
Corrosion of coupling	33
Compression coupling leaking	15
Valve leaking	20
Damaged by construction	37
No leak	4503
Total service cards	5562

Observed Corrosion of Gas Services of Various Ages

Fig. 1 shows a plotting of the average degree of corrosion observed on the non-leaking gas services exposed in the 11-month test period. The cards were sorted by 10-year age groups and the number in each group reported as "good as new," "slight corrosion," "heavy corrosion," and "deep pits" was counted. Arbitrary values of 0, 1, 2, and 3 were assigned to these four degrees of corrosion and the averages for the various age groups were computed.

The initial assumption was that the points would fall in such a pattern that a single curved line could be drawn thru them. Deviation of the pattern of the points from this assumed arrangement is too great to be produced by chance alone. Some of the points represent as many as a thousand individual observations. After considerable detailed analysis, it became practically certain that the curve thru the points should be drawn with a discontinuity, or really as two curves.

The portion representing ages of pipe up to 50 years shows the progress of corrosion of a mixture of bare and coated steel pipe with a small amount of wrought iron. The coated and wrapped pipe predominates in the first 15 or 20 years of age and from 15 to 50 years of age it is mostly bare steel — some galvanized and some not. The portion of the curve beyond 50 years of age represents the progress of corrosion of a mass of pipe, predominately bare wrought iron.

Effect of Type of Soil On Apparent Corrosion

Among the data indicated on the inspection cards is a determination of the type of soil surrounding the particular pipe on which the report is being made. In preparing Fig. 2, the soils as reported were divided into two groups, one considered corrosive and one considered favorable, and the data plotted accordingly.

Measured by their corrosive effects on steel, wrought iron and cast iron, the soils divide themselves into three groups.

Corrosive:
- Muck
- Cinders
- Blue Clay
- Red Clay

Fairly Favorable:
- Shale
- Mixed Soils

Very Favorable:
- Sand
- Gravel

Apparently, corrosion proceeds approximately twice as rapidly in corrosive soils as in favorable soils.

Effect of Type of Soil On The Reported Leak Rate

Points representing the average number of leaks appearing per year in services gathered into 10-year age groups are plotted on Fig. 3 as *leaks per 100 services* existing in the group. The data are divided between those for services in corrosive soils and those for services in favorable soils.

A reasonably acceptable line can be

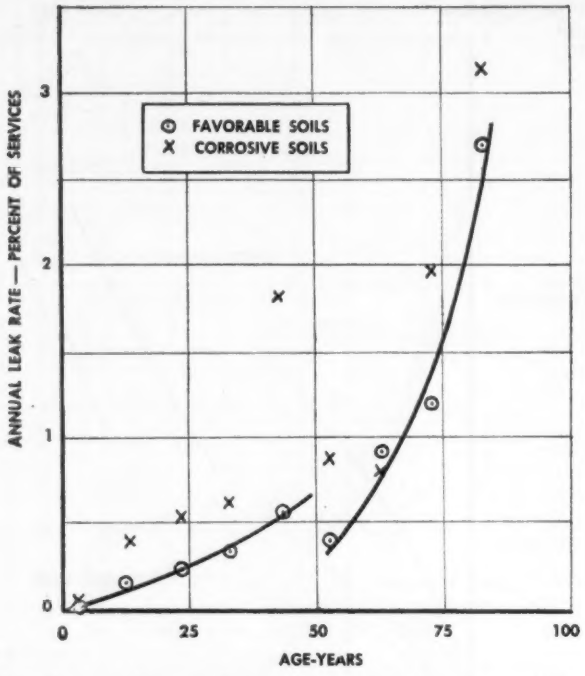


FIG. 3. **Gas services — *Corrosion leaks Vs Age,*** in favorable and corrosive soils. "X" indicates corrosive soils, "O" (circle with dot) indicates favorable soils.

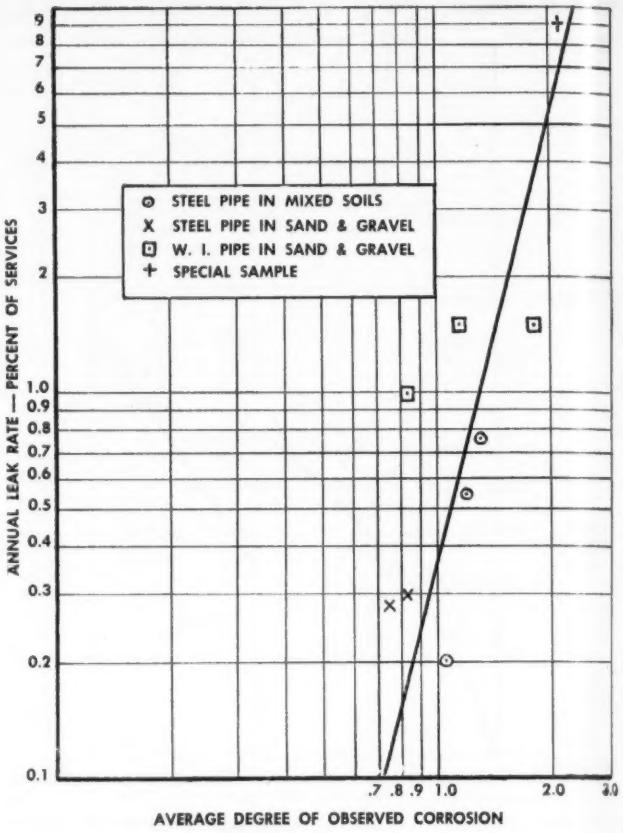


FIG. 4. **Bare gas services — *Annual leak rate Vs Degree of corrosion.***

drawn thru the points for steel services in favorable soils and thru those for the older wrought iron services in favorable soils. When it comes to the unfavorable soils, the points are much more erratic.

A detailed analysis of the reports on the 40-to-49-year age group of services in unfavorable soils gives a clue to why this is so. Over half of the leaking services observed in this group did not appear as publicly reported leaks, but were found when wholesale area digups were made in advance of new pavement.

It was apparent that many, if not most, of these services had lain for years in a perforated condition in clay soils dense enough to prevent the low pressure gas from escaping.

This fact leads to the important conclusion that figures for reported leaks per year for services in dense soils cannot safely be used to determine the annual rate of development of new leaks in service piping.

We can, however, reasonably trust the leak data gathered from reports on services in soils porous enough to let the gas escape and be detected as soon as the service pipe is first penetrated. We can then examine the relationship between the leak rate and the degree of observed corrosion for groups of similar pipe in these porous soils. If a valid pattern of correlation appears we shall have found a valuable tool for estimating the rate of leak development of pipe buried in the denser soils.

Relationship Between Leak Rate And Degree of Observed Corrosion

For each 10-year age group of services in each reported type of soil we can compute the average degree of observed corrosion of the random sample of non-leaking services as reported by the field crews. Likewise, the number of leaks reported for the group in the test period can be expressed as a percentage of the number of services existing in the group at the start of the period.

If we limit our data to those for bare pipe and to those for soils porous enough that leaks may be expected to be reported very soon after they start to develop, we should be able to plot the leak rate for each group against the average degree of observed corrosion for the group and to determine whether a consistent correlation exists.

Fig. 4 shows points for all of the usable groups as defined above. In addition, near the top of the chart is a point determined by detailed analysis of a 100 percent digup, in advance of paving, of a group of some 350 services in a very dense and corrosive clay soil.

Log-log paper is used for plotting so that the curve can be expressed as a straight line.

It should particularly be understood that the various points represent groups of services of widely different ages. The circumstances that a certain group of wrought iron services in sand or gravel shows a higher average degree of observed corrosion and a higher annual leak rate than another group consisting of steel services in much more corrosive mixed soil is due to the fact that the first group is 20 to 40 years older than the second.

There seems to be no reason to believe that the relationship between observed corrosion and the leak rate, which we have established from data on porous soils, should not be valid for the dense soils, where the true rate of leak development cannot be found without special digups. The alignment of the data for the one such substantial digup available to us as plotted on Fig. 4 seems to confirm this assumption.

Since the average degree of corrosion of services in clay soils can be determined, the current rate of leak development can be estimated by reference to Fig. 4.

As an example, let us assume that we have 10,000 services in dense clay soils in an age group averaging 25 years, and that the average degree of corrosion of a random 5% sample of this group, observed in the course of normal exposure over a period of time, is 1.4.

From Fig. 4 we find that the rate of new leak development corresponding to a degree of corrosion of 1.4 is

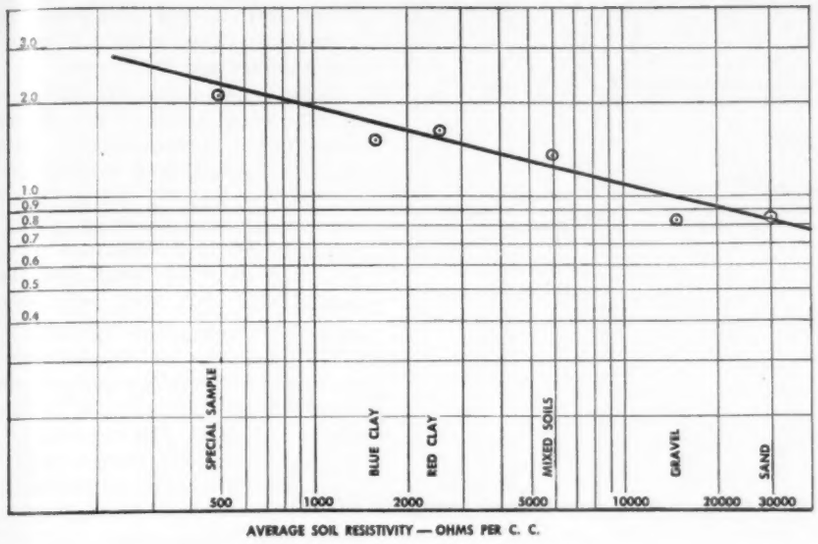


FIG. 5. **Bare gas services — *Degree of corrosion Vs Soil resistivity*, compared for 40-to-49 year age group.**

1.36% per year. We are currently recording, however, only 50 leaks a year or 0.5% of the 10,000 units in service. This means that we are currently developing undetected service pentrations at a rate of $\frac{1.36 - 0.50}{100} \times 10{,}000$ or 86 a year.

We may safely "guestimate" that we have in our 10,000 services, averaging 25 years old, about 800 incipient leakers. As the group advances in age, this concealed group of potential leakers will grow. Since the figure for degree of observed corrosion is not now available to every one, and is a considerable task to determine, an attempt will not be made to develop the relationship between the leak rate and the resistivity of the soil in which the pipes are laid.

Relationship Between Observed Corrosion and Soil Resistivity

It has been determined that the degree of observed corrosion rises with age, more rapidly in some soils than in others. The common factor that appears to relate the soils to each other quantitatively seems to be their resistivity.

Using arithmetic means of published ranges of resistivity of the various soils as values for plotting, Fig. 5 was prepared, showing the relationship of corrosion and resistivity for the oldest available age group of steel services. It happens that the previously mentioned 350 service digups in very corrosive soil falls within this age group. Only the observations of the **non-leaking** services in this group were used in determining the point on this chart.

The excellent correlation between the plotted points and the straight line leads to the conclusion that, at least in this geographical area, the development of corrosion is a function of soil resistivity as well as of age.

It should be remembered that the points plotted on Fig. 5 are from data on random observations, completely separate and independent of the leak data plotted on Fig. 4.

Relationship Between Leak Development and Soil Resistivity

Fig. 6 shows the relationship between the annual rate of leak development and soil resistivity for gas services laid between 40 and 49 years ago.

The line is derived from the lines plotted on the two previous charts. On both of these charts straight lines were drawn to fit the observed points, but on this chart (Fig. 6), the line was drawn from an equation* developed from the equations of the lines on the other two charts. Plotted points are shown merely to observe their relation to the line.

"Why plot the leak rate against degree of corrosion, then plot degree of corrosion against soil resistivity and finally combine the two? Why not plot leak rate directly against soil resistivity?"

The answer is that the three step procedure permits using more points to establish the line than otherwise would be available. On Fig. 4, age is not a factor, so the points available from all age groups can be plotted. On Fig. 5, all soils can be used. The degree of observed corrosion of services in clay soils can be determined as well as in any other soils. Because the dense clay soils conceal many of the leaks that have developed in the pipe and fittings, there is no way to determine the true leak rate directly, except by digging up all the services in an area. The point plotted on Fig. 6 at 500 ohms was obtained in that way.

The line on Fig. 4 was established from 10 points and that on Fig. 5 from six points. Fig. 6 has only four points, and without the special circumstance of having a major digup in extremely low resistivity soils, it would have had only three points, all in the high resistivity portion of the chart.

Suppose that we have 1000 services averaging 45 years of age in a certain area of a city where the soil is known to be both dense and corrosive. Let us

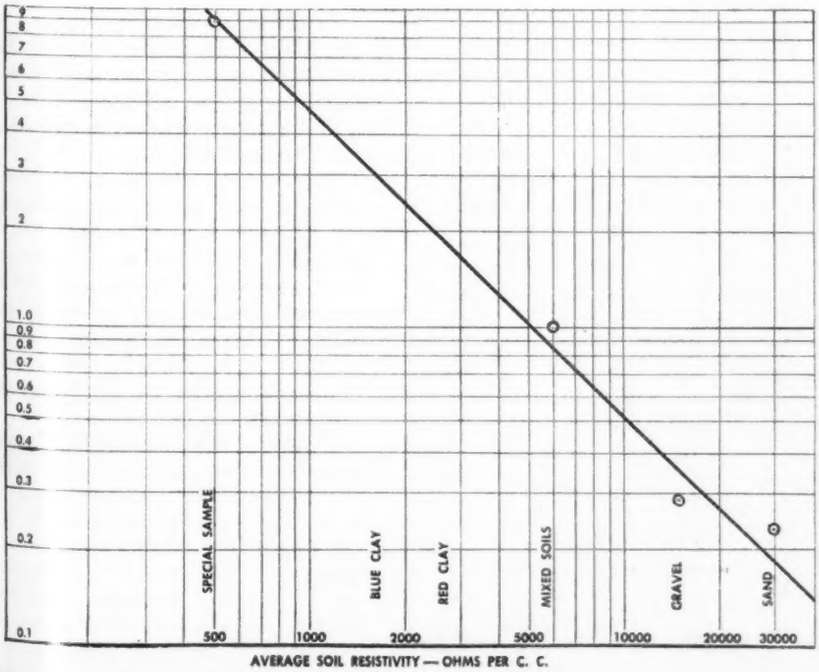


FIG. 6. **Gas services — *Annual leak rate Vs Soil resistivity*, compared for 40-to-49-year age group.**

*See Note 1.

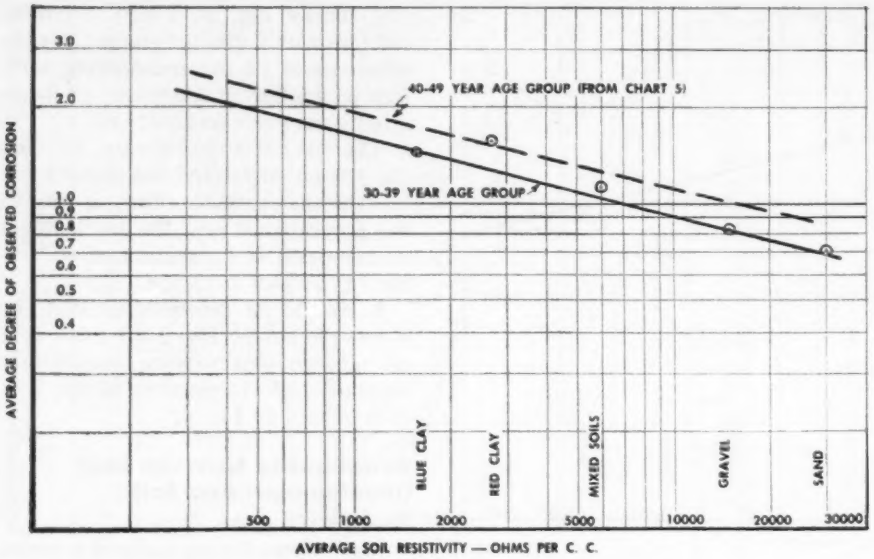


FIG. 7. **Bare gas services — *Degree of corrosion Vs Soil resistivity.***

say that a few test measurements in the area indicate that the soil resistivity runs from 800 ohms to 1200 ohms.

From Fig. 6 we can see that new leaks are developing in the services not already punctured at a rate of from 4% to 6% a year.

If our observation has been that we are getting very few weak leaks reported or services replaced in the area, we may figure, without a very rigorous calculation, that about half of the services have been penetrated and are ready to leak gas as soon as the soil is disturbed. This information could be very valuable to management in justifying a replacement program.

Strange Performance of Gas Services in Early Years of Life

Fig. 6, showing the leak performance of services as related to soil resistivity for facilities averaging 45 years of age, demonstrates a close correlation of the points to the line. The younger age groups, however, fail to produce such a tidy pattern.

For the 30-to-39-year age group, the correlation between the degree of observed corrosion and soil resistivity is quite good. (Fig. 7).

When the leak data are plotted against soil resistivity, however, all of the points lie well above the line. (Fig. 8).

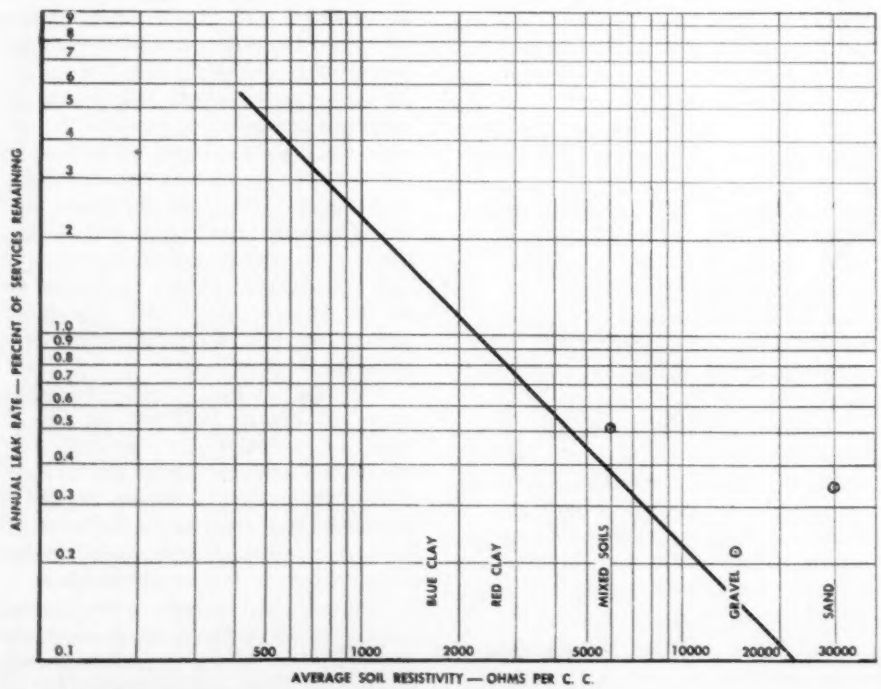


FIG. 8. **Gas services — *Annual leak rate Vs Soil resistivity,*** compared for 30-to-39-year age group.

The 20-to-29-year age group shows a similar and even greater diversity between theory and the record.

Taking an entirely different approach to the understanding of this phenomenon, Fig. 9 has been prepared. On this chart the annual leak rate figures for the sand and gravel soil groups have been recalculated as percentages of the numbers originally installed at each group of dates of installation. These annual leak rates have been plotted against average ages of the groups.

On the same chart has been plotted the line of theoretical failure of units in a uniform population having an average life of 100 years. The exactness of the assumption of 100 years average life is not particularly critical in comparing the patterns of actual failure rates and theoretical failure rates.

Again, we see that, in the early portion of the life of the plant, the failure rate is much higher than would be expected from theoretical considerations. Under the assumptions used on this chart, in the first 50 years of life of services in sand and gravel, about 2% of the services should have failed. Actually the experience data indicate that 9% have failed.

Conclusions

1. **The rate of development of concealed leaks in dense soils** can be determined with reasonable accuracy, at least in our climate and glacial soil conditions, from facts of age and soil resistivity.
2. **Early leaks are going to develop in all soils,** even with coated and wrapped pipe, at rates much higher than would be statistically anticipated.

The first conclusion hints at the feasibility of minimizing future leaks in existing plant by establishing replacement programs developed, area by area, from consideration of data on age and nature of soil.*

The second conclusion sounds a warning that the industry must develop better service installations for the future. Perhaps materials other than steel will be developed that, besides preventing these early corrosion leaks, will not introduce a new set of defects of their own. Perhaps adequate cathodic protection of steel pipe will prove to be the best answer.

Certainly, field installation of coated pipe alone does not seem to be achieving the complete perfection necessary to do the job. Another thought is to use a sandy material for backfill and to bring up the service on the outside of the building for an above ground entrance. The sandy fill would probably improve the life of the pipe and a vent installed at the riser would permit

*Note 4

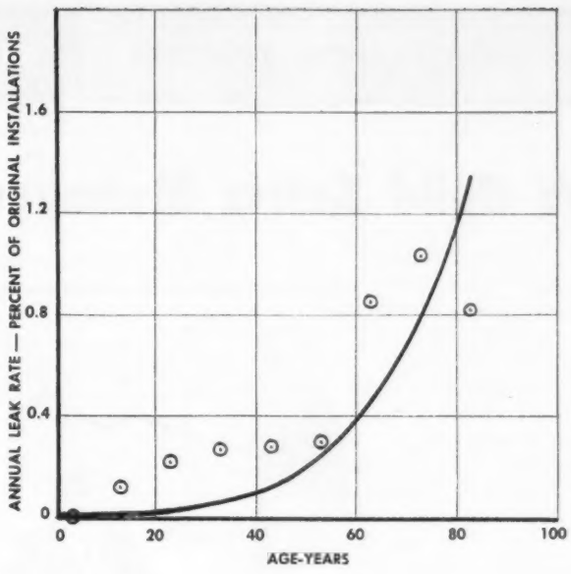


FIG. 9. **Gas services in sand and gravel — *Annual Rate of leak development*** (expressed as percent of number originally installed) ***Vs Age of service.*** Chart shows actual average of 10-year age groups and theoretical rate (solid line) for 100-year average life. In first 50 years, 2% theoretically fail; actually, 9% failed.

leaking gas to escape to atmosphere. It would also provide an easily accessible point to test for the presence of gas.

In summary, this discussion is primarily intended to demonstrate that statistical analysis of such field data — as is available to us — can prove to be a useful tool for management to use in determining the measures most likely to succeed in keeping our losses down and our operations safe.

Acknowledgment

This article developed from a presentation made at the 1960 A.G.A. Operating Section Distribution and Transmission Conference, New Orleans, Louisiana.

NOTE 1

Derivation of Equations

FIG. 4

Let L = Annual leak rate — percent of services existing at start of test period.

D = Average degree of observed corrosion.

The equation of the line is:

$$L = aD^n$$

where $a = 0.36$

$n = 4.0$

FIG. 5

Let R = Soil resistivity – ohms per $cm.^3$

The equation of the line is:

$$D = bR^m$$

where $b = 10.0$

$m = -0.24$

FIG. 6

Substituting bR^m for D in the equation for Fig. 4, we have the equation for the line on Fig. 6:

$$L = ab^nR^{nm}$$

The values of a and n are constant for all age groups, but b and m vary as follows:

Year Group	b	m
40-49 yrs	10.0	−0.24
30-39 yrs	9.0	−0.25
20-29 yrs	8.0	−0.27

NOTE 2

Allocation by Soil Types

Reference has been made to numbers of services existing in various soils. This has been estimated by finding the percentage of cards representing **non-leaking** services in each soil classification. These percentages were applied to the total number of services existing in each age group to estimate the number of such services in each soil type.

NOTE 3

Other Available Data

In addition to what has been reported on in this discussion, a wide variety of additional data is being collected. Most is not yet in sufficient volume to lead to reliable conclusions. A few of these items are listed below; any one particularly interested in any of them is welcome to preliminary figures on request:

A. **Breakage of cast iron pipe.** It will take several years to accumulate enough data on this subject to be truly conclusive. Preliminary figures indicate, as might be expected, that the breakage rate of 3-in. main in a severe winter is very high. Somewhat better are the 4 and 6-in. mains, but the real dividing line between good and bad seems to be between the 6-in. size and the 8-in. Since the smaller pipe tends to be older, age is, of course, a factor.

B. **Graphitization of cast iron pipe.** Correlation between the development of graphitization and age and soil resistivity seems to be similar to the correlations for steel services described in this discussion.

C. **Corrosion of steel mains.** Correlation between observed corrosion and the rate of leak development on steel mains is, quantitatively, quite different from that for services. The deterioration of mains is much more uniform throughout their length than is the case with services, where the first foot next to the main may be completely corroded and, two feet away, the pipe may look good as new.

D. **Effect of wall thickness on leak rate.** Our efforts to squeeze anything out of the data to shed light on this subject have not been rewarding.

E. **Efficacy of coating without cathodic protection.** The effectiveness of the technique of evaluating the condition of a large volume of pipe by inspection reports on a small sample is considerably hampered by the coating.

The leak rate figures accumulated to date, however, fail to show any great benefit from coatings of 10 to 40 years ago, at least on services. The fault seems to lie with the installation forces. It will probably be several years before we accumulate enough data to make a responsible quantitative analysis.

F. **Effect of sandy backfill.** We are taking samples of sandy backfill used in past years in place of clay spoil. The samples will be tested for resistivity to find out whether the backfill tends to retain its original characteristics or fairly rapidly assumes those of the parent soil around it.

NOTE 4

Replacement Program Suggested by the Data

Based on the data available for this report, a long range program of replacement of underground facilities might shape up something like the following:

SERVICES

1. All services over 60 years old.
2. Services in clay and mixed soils, 40-60 years old.
3. Services in clay 20-40 years old.
4. Services in mixed soils 30-40 years old.

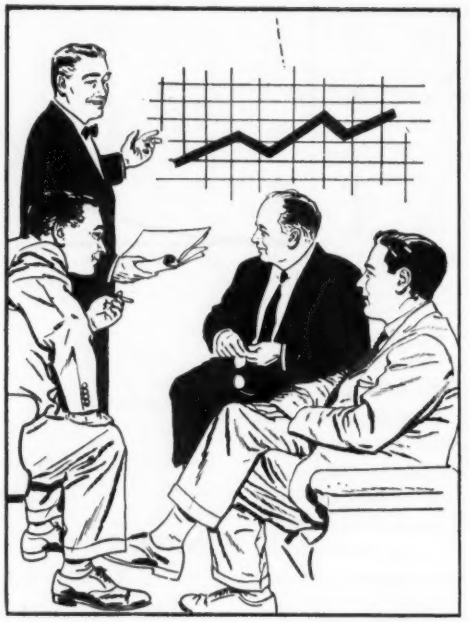
CAST IRON MAINS

1. All 3 in. (largely over 50 years old).
2. 4 in. in clay over 60 years old.
3. 4 in. in clay 50-60 years old.
4. 6 in. in clay over 60 years old.
5. 4 in. in other soils over 60 years old.
6. 4 in. in clay 40-50 years old.
7. 6 in. in clay 50-60 years old.
8. 6 in. in other soils over 60 years old.

* * *

Capable Supervisors Build Better Management Teams

R. D. Stevens,
Management Consultant, Washington, D. C.



IN THE DAY-TO-DAY OPERATIONS of a company engaged in the distribution and utilization of natural gas and merchandising of gas appliances, personnel problems arise that affect sound management-employee relations. They may deal with procedure of time-studies, job-evaluation, assignment of jobs, work orders, disciplinary action, transfer and promotion, management prerogatives, or other matters.

Success of the gas utility company in getting work done is determined to some degree by the willingness of employees to do their jobs and their eagerness to do the job well. Dissatisfied employees do not contribute their best efforts.

The subject of good supervision is an important one. So very important, in fact, that management must continually make an effort to keep supervisory people well informed about practices that constitute good supervision. Supervisors cannot apply good management techniques, then fail to properly manage the human element. Everyday, in some way, your company is encountering supervisor-employee problems that affect operations.

Alert Supervisors Needed

To keep operating at maximum efficiency, supervisors must be alert to recognize symptoms of employee grievances. They should try to analyze the causes that give rise to these symptoms and seek to prevent grievances from developing.

We are now going through an almost unprecedented period of change — automation, electronic computers, growth and diversification, and shortage of skilled manpower. This period of change accentuates the need for good supervisors.

In view of the importance of the subject, each company should develop a systematic means of solving personnel problems at the supervisory level so that management can devote its time and effort to overall analysis of business.

While there is no magic formula for getting the job done, there is a standard set of procedures that a gas distribution company can follow mechanically. Of course, each company must tailor its program to its needs.

The company must have employees who seem to exhibit characteristics usually found in supervisors and who are a part of the management team.

A competent supervisor is a person who makes things happen, through the efforts of other people. In so doing, he is primarily concerned with obtaining management results.

He must know what is to be done, how the work will be divided, how the work will be done, who will do the work, when the work will be done, how well the work must be done, and how well the work is done.

Finding intelligent answers to these questions requires the supervisor to use managerial effort, that is familiarity with working processes, and a reasonably clear understanding of what makes people tick.

Sound management-employee relations are essential to a company operation. It is possible to get a better day's work from supervisors and employees alike when mutually satisfactory relationships exist among them.

Handling and solving personnel grievances requires an understanding of people and the kinds of satisfactions they need from their jobs. Efficiency in operation at the lowest possible cost requires the most effective use of each worker's potentialities. It requires competent supervision so that employees will develop and grow into greater usefulness in the company.

Supervisors must maintain their capabilities on a continuing basis. Welding employees into a functioning unit is a process of developing teamwork. **The job of any supervisor in handling personnel is to create a favorable working climate.**

A supervisor, therefore, is a person to whom certain authority has been delegated to direct the work of others and who has responsibility for their work output. The objective of good supervision becomes, then, improvement of the efficiency and economy of company operations by developing a well-trained work force, assisting employees toward achieving their highest potential usefulness, and proper handling of grievances at the supervisor level.

Detecting Grievances

There was a time when relationships between supervisor and his employees were relatively simple. Today, this is not the situation.

It is true that the employee's conduct may be his way of unwittingly showing that he has a grievance. He may show it through reduced productivity, poor quality work, loafing on the job, insubordination, or lack of cooperation with the supervisor.

It seems important that a supervisor recognize that, regardless of the seriousness of the personnel problem as it appears to him, the way the employee feels about the matter at the time should dictate the amount of consideration to be given to the complaint. The supervisor who gives an employee the brush-off or makes too light of the complaint is merely adding fuel to the fire.

Promoting the will to work requires good supervision. Employees in your company usually have the knowledge and skill required to perform their jobs, but they look to the supervisor for instruction and guidance.

Value of good personal relationships between the supervisor and his employees cannot be overestimated—it is through such good relationship that he is able to settle more grievances.

Right now is a good time for the supervisor to start sizing up his own job and determining what management expects of him. The type of manager a supervisor can become depends upon what he does to make himself management material. The supervisor who is alert and is a manager of men must have the desire to learn and the willingness to pay the price of financial success.

Avoid By-Passing

In most cases, "by-passing" can be avoided by the supervisor himself, through building up in the employee's mind, faith, confidence, and trust as a result of his daily practice by:

1. **being interested**
2. **anticipating annoyances** that are certain to arise in any job.
3. trying to **learn personal characteristics** of different employees and their customary reaction to various job circumstances, and,
4. **by exercising patience,** objectivity, and tolerance of people even under stress of fundamental disagreements.

Obviously, it is not an easy matter for the supervisor who has to live with the complaining employee to be wholly objective at all times in considering the personnel problem. But, the supervisor should give the employee some thoughtful attention, listen to the story without interrupting, and try to keep the discussion centered around facts rather than on opinions which might give rise to needless argument.

Seek a Solution

Whatever the solution, it should: Reach the heart of the problem, remove the cause of the grievance, and have no effect upon the work of other employees.

There will, of course, be times when informal discussion between employee and the best of supervisors will fail to resolve a personnel problem. There also will be times when conditions require company management take some adverse action against the employee. But to keep the record straight, establish the facts, discourage petty complaints, the company should see that the grievance is reduced to writing.

Authorities in personnel management agree upon certain basic principles in handling this matter. **First,** improvements can be made mainly through better initial preparation of the grievance; **second,** through better conduct of the hearing, and **third,** more thorough preparation by the supervisor and his report to your management.

Prevent Grievances

It is not enough that supervisors know how to handle employee grievances as they arise. They must also work toward preventing grievances, or at least reducing them to a minimum.

One of the advantages of the supervisor's job is that it continually offers challenging problems that demand attention. Each action he may take, that results in a correct solution to personnel problems, constitutes growth in his stature as a manager.

A competent supervisor looks upon his people as individuals. Everything he does and says adds to their opinion of him as a person, and influences the way they respond and react to their jobs under his supervision.

Essentials of Supervision

The management level of a supervisor demands the ability to work as a member of a team. Every company management considers this ability a major asset as indicated by the efforts expended to develop such traits in supervisors and prospective supervisors.

"BESIDES INVESTING, MERGING, AND EXPANDING, DOES ANYONE KNOW HOW WE CAN MAKE A FEW BUCKS?"

Most employees in your company report to the supervisor. They get their work orders, supervision, discipline, and their main recognition from him. Few employees come in contact with anyone above the supervisor. To them, the supervisor is management.

The supervisor's job is to use people and equipment assigned to him, for the purpose of getting work done under conditions specified by management. In order to accomplish this, he has to perform a multitude of duties and responsibilities.

If a supervisor does not enjoy good personal relationships with his employees, they may choose to take their grievances to outsiders. There is evidence that good supervisor-employee relationships have been responsible for smoothing out many grievances that otherwise may have gone to arbitration.

Qualifications of a Supervisor

A realization of the qualifications necessary for a good supervisor should result in a more careful selection of candidates. Recent management studies indicate, generally, the following qualifications are most desirable in a supervisor:

Leadership and organizing ability,

Character,

Judgment,

Technical skill,

Initiative,

Physical and emotional capacity to carry out responsibilities and perform his duties well.

When the company selects a person to step into a supervisory job, it is a process, not an event. There should be many ways for supervisors to really become a part of the management "team."

Management should try to find people within its own organization who can be promoted to the job of a supervisor whenever a vacancy occurs. This should be done because it has a definite bearing on the growth and development of better supervisors. Basically, this procedure helps stimulate job interest.

Supervisory Know-How

How to train potentially successful supervisors is one of today's most vital concerns. The fewer supervisors in a company, the greater responsibility each has to carry. What does your supervisor do? What is he actually expected to accomplish? Is he being asked for too little? A written job description will help clarify the supervisor's function. It is a diagram of the duties, responsibilities, skills, and requirements of his job. It is concerned with the job itself, not with the individual supervisor.

One practical way of apprising supervisors — new or experienced — is with a rating sheet that lists each of the qualities required of them, with varying degrees of achievement possible for each quality. By looking at this record, you can readily appraise a supervisor's qualifications and know-how.

Supervisors should be able to command a working knowledge of the company—its history, nature of organization, operating methods, general policies, and immediate and long-range objectives. He must know and understand the duties assigned to him and the routine activities required.

Supervisor's Requirements

The **"can do"** and **"will do"** traits listed will have some bearing on almost every supervisory job. Not all traits are equally important, however, ordinarily, it is enough for the company management to decide which traits are important and which are necessary.

Can do factors —

job knowledge and skill;

mental alertness;

health and physical condition;

verbal expression

Will do factors —

job motivation *(habits, motives and drive to work diligently and productively in his job)*

stability *(remaining in a given situation for a reasonable length of time)*

perseverance *(in spite of difficulties and opposition)*

self-reliance *(doing things for himself rather than depending on others)*

cooperation *(work with others to achieve a common goal)*

competitiveness *(accept activities in which you can compare his record with that of others)*

loyalty *(puts your company's interest above his own)*

ability to get along with people *(to establish good working relationships and gain personal acceptance by people)*

leadership *(capacity to organize and direct others)*

emotional maturity *(a balanced personality evident in his attitude toward his work, the company, and other employees).*

But, the supervisor himself must make use of these traits. There are no short-cuts to good supervisory performance — it evolves good judgment and hard work.

Use of Arbitration

Your company should be training the supervisor in fundamentals of sound human relations because most employee grievances start right on this first line. A supervisor with the proper know-how will do much to solve personnel problems before they get started. A great many employee grievances that go all the way to arbitration, might easily have been settled by the supervisor who usually can tell when grievances are brewing and often can do much to stop them before they start. Adequate training, however, is the only way a company can qualify the supervisor to handle this phase of his work effectively.

Today, it is a common practice for disputes between management and labor to be arbitrated. Arbitration is a peaceful, voluntary method of settling disputes. It is used only after both parties have failed to reach an understanding. After a hearing, at which both parties voluntarily submit their evidence and claims, the arbitrator makes a decision and issues an award that the respective parties have voluntarily agreed to accept in advance.

There are two unvarying elements that must be present in labor arbitration. First, the arbitrator must be impartial. Second, there must be a final and binding decision embodying the judgment of the arbitrator, not merely an attempt to bring the parties together in their own settlement. The decision must be within the authority granted to the arbitrator.

By large and far, arbitration is an informal and flexible process. The parties themselves, by mutual agreement, establish their own rules of procedure, select the arbitrator, fix time limits, define the problem or issue, and mutually agree that, within the limits of the arbitrator's authority, the decision shall be final and binding.

In collective-bargaining, it is customary to distinguish between questions of interpretation or application of specific clauses in agreements that have been negotiated and are in force and disputes over the terms to be included in a new agreement. The absence of an arbitration provision does not, of course, preclude a company from deciding to use the method. Scope of arbitration under your agreement depends basically on the contents of the agreement itself and the authority granted to the appointed arbitrator.

In choosing an arbitrator to decide company employee disputes you should realize that he should possess the following qualities: Impartiality, intelligence, sound judgment, ability to resist pressure tactics, adequate knowledge of the gas distribution industry, fairness, and perhaps a judicial temperament.

In any case, it is customary for the agreement to provide that both parties involved shall share equally the cost of arbitration. Or, it may also be provided that the losing party will pay the totals.

The company may present its case by either oral discussion or by way of a written brief. The method used will largely depend upon the nature of the case and preference of the parties.

Time limits may be specified to avoid delay in settling your company's labor dispute and also to prevent obstruction of the arbitration process.

Since the purpose of arbitration is to obtain a final and conclusive settlement, your company should specify that the arbitrator's decision is final and binding.

Some awards are only short summary statements or decisions. This method of handing down an award has the advantage of saving time and of being concise. You realize that an award, coupled with a long and argumentative opinion, might well be confusing.

Use of arbitration after the grievance machinery has broken down, can be a great step forward to the betterment of the management-labor relations.

Other Pointers

What can and should the supervisor do to prepare himself to handle employee grievances at his level?

He must reorient his own thinking. He should think of himself as a manager rather than as a technical worker. He also should realize that the direction of people is much more than communication. It is the process of weaving people and their performance into the company's operating system.

Finally, the role of human relations should be appraised by the supervisor in each managerial situation in terms of the nature of the work, nature of the people he supervises, and the extent of their contributions.

To find out whether or not the supervisor's ability has been effective to the extent that he can handle and solve employee grievances at his level, management needs to evaluate the results. Such action, if consistently practiced, will lead to better understanding of what bothers people and, a more logical approach to correcting the causes of grievances and complaints.

Much of a company's personnel program will be expressed through published policy statements. This is good; too often, however, policies are expected to become self-operative with putting life, warmth, and meaning into too little direct effort being spent on them.

Why not take an inquiring look at your company policies occasionally to see how effective they really are in helping the supervisor solve personnel problems at his level? ★ ★ ★

Welding with paint brushes. Fitters apply special solvent weld cement with brush to join sections of plastic pipe. Cement softens material of pipe and connecting sleeve; when dry, two are fused together into a single homogeneous material.

Padding pipe. As pipe is laid, it is covered by hand with soft dirt to protect line from sharp rocks. When pipe is sufficiently "padded," backfilling is completed by construction equipment.

Ohio Fuel Installs All-Plastic Distribution System

AGJ Staff Report

FIRST USE OF PLASTIC PIPE on a community-wide scale for a natural gas system was made recently by The Ohio Fuel Gas Company in extending service to the new market of North Robinson, Ohio.

With the exception of the medium pressure supply line that brings gas to the community, the entire distribution system was constructed with an ABS type plastic pipe — 4940 ft of 2, 3, and 4-in. sizes. The $25,770 project made gas service available to 84 homes and stores plus a new school in the village of 250 population.

Use of plastic pipe, notes Paul W. Rogers, Ohio Fuel vice president and chief engineer, will help reduce operating expense while maintaining the company's high standard of service. Ohio Fuel expects substantial savings by using plastic pipe. Non-corrosive, it can be laid bare in the ground, contrasted to steel pipe, which must be coated and wrapped for protection against corrosion.

Savings are also found in the fact that the plastic pipe is lighter and easier to handle. Plastic pipe sections installed by Ohio Fuel are joined by a simple solvent weld method and use of connecting sleeves.

Construction of the new system followed conventional plastic pipe installation practices with some "added touches." To aid in locating the plastic pipe after it is backfilled and placed in service, construction crews taped metal wire along the top of the pipe. This enables electronic pipe detectors to accurately locate the lines when and if necessary at a later date.

Care was also taken to protect the

Easy to handle. Don Poffenbaugh, Ohio Fuel Gas Company fitter easily lifts three 20-ft sections of 4-in. pipe as work gets underway on installation of all-plastic pipe distribution system in North Robinson, Ohio.

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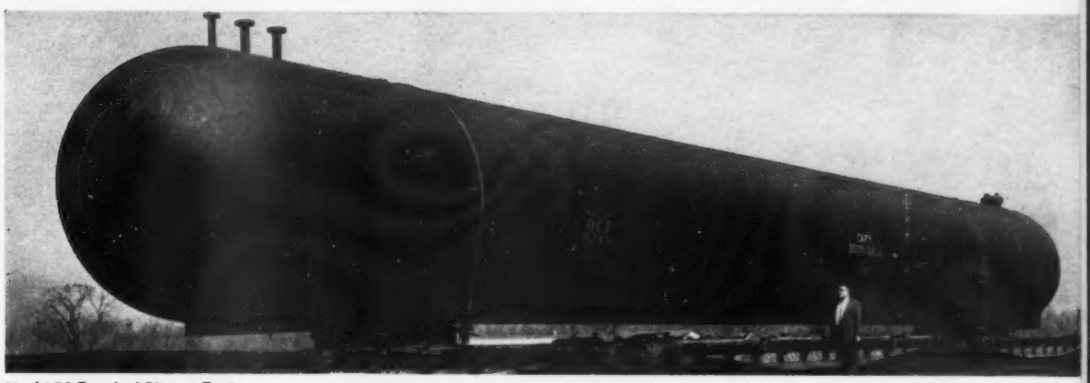

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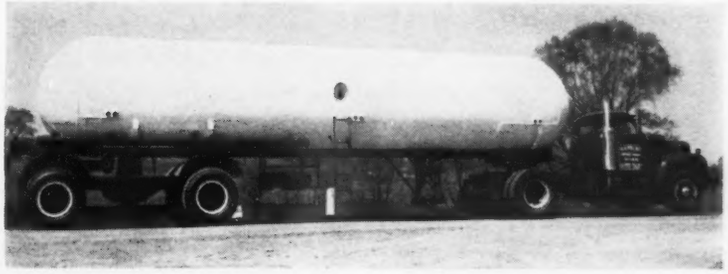

T-1 "Bonus Blimp" LPG Transport

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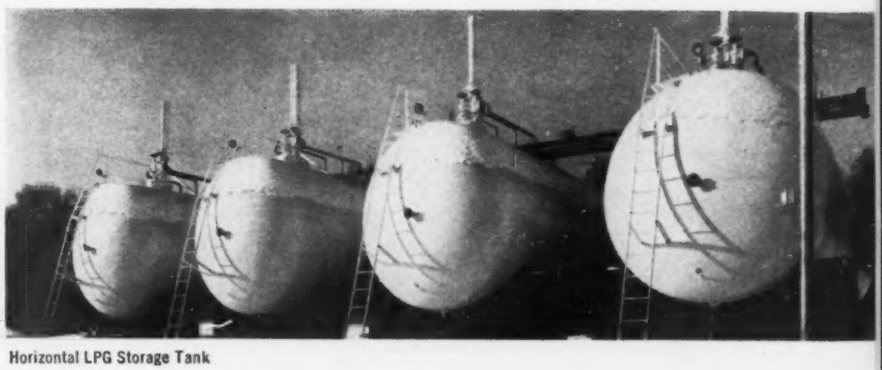

Horizontal LPG Storage Tank

Easy to cut and trim. A handsaw and mitre box is all that's needed by fitter Ray Barnett to cut a piece of plastic pipe.

Plastic curb box. C. E. Dray, left, Marion division plant and service foreman for Ohio Fuel, and Walter E. Dougan, Columbia Gas System Service Corporation valuation engineer, examine plastic curb box used in the North Robinson system.

pipe against penetration by sharp rocks during the installation. Workmen hand shoveled soil into trenches to provide sufficient padding and cover for the pipe before backfilling with construction equipment. Plastic curb boxes were installed at all curb cock locations.

The North Robinson system installation, while representing the first total installation of its type by Ohio Fuel, is not the first use of plastic pipe made by the gas utility. Test sections of plastic pipe have been in use at a number of locations in the company's territory during the past several years. Chief engineer Rogers terms the test installations as "completely satisfactory in all respects."

Pipe used for the North Robinson project is made of acrylonitrile-butadiene-styrene plastic, extruded by Carlon Products Company of Aurora, Ohio. The Ohio Fuel crew that installed the pipe underwent a training program at the Aurora plant prior to working on the project.

* * *

Lightness and flexibility of pipe make it easy for fitters to push sections into place to ready them for "welding."

Detection wire taped to pipe allows electronic detectors to accurately locate plastic line after it is covered and in service.

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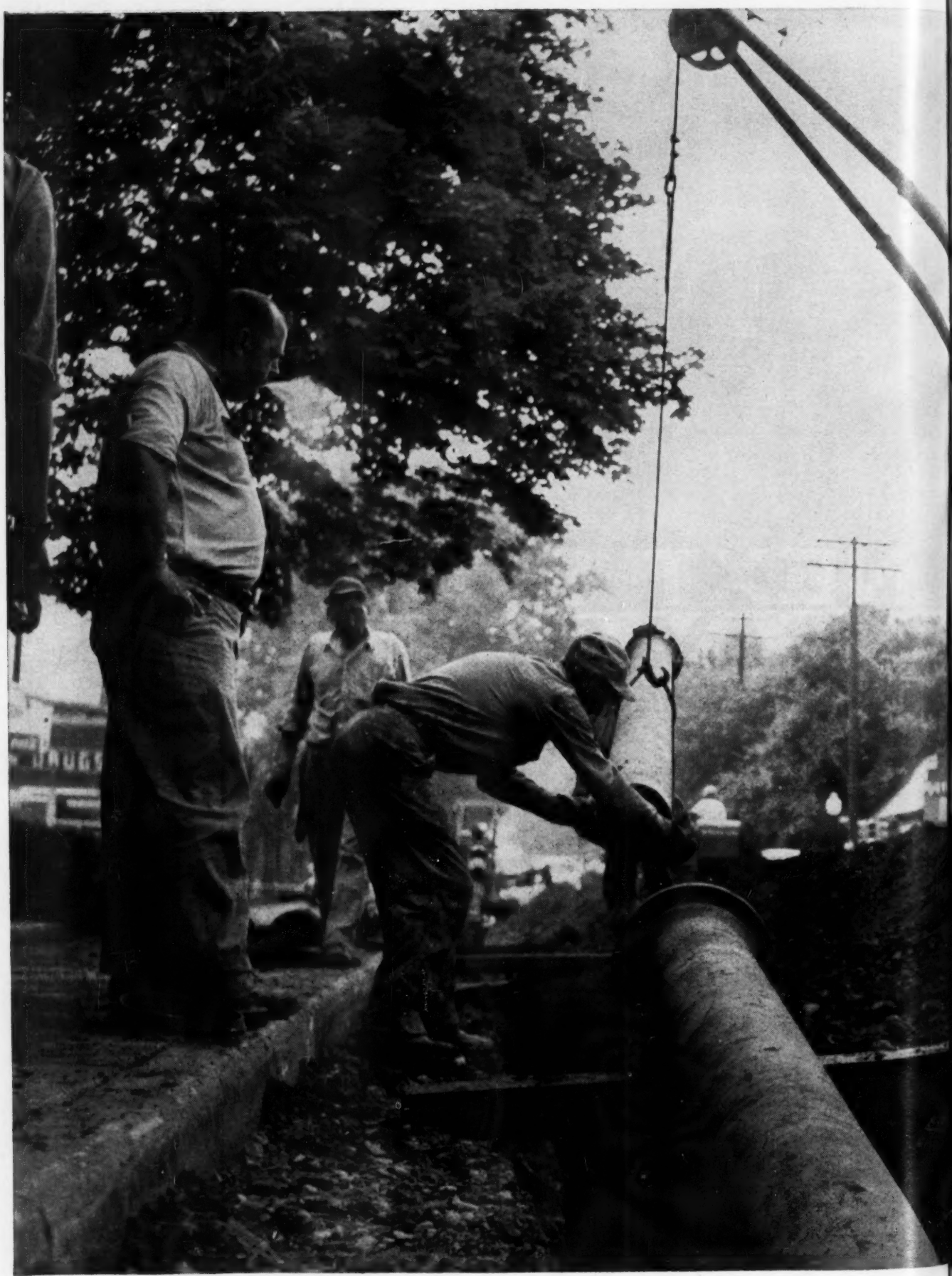


INSTALLATION IS A CINCH WHEN YOU CHOOSE CAST IRON PIPE

One of the reasons so many pipe experts prefer cast iron pipe is because it installs so easily—requires no coating or wrapping. As you see, the crew at the left is assembling the convenient lengths of cast iron pipe before trenching them—a particularly valuable time-saving operation when work crews must combat the handicap of wet trenches.

Besides being easy to handle, cast iron pipe is inherently rugged: it withstands all the usual stresses to which underground pipe is normally subjected; its modern mechanical joints remain tight under normal distribution pressures.

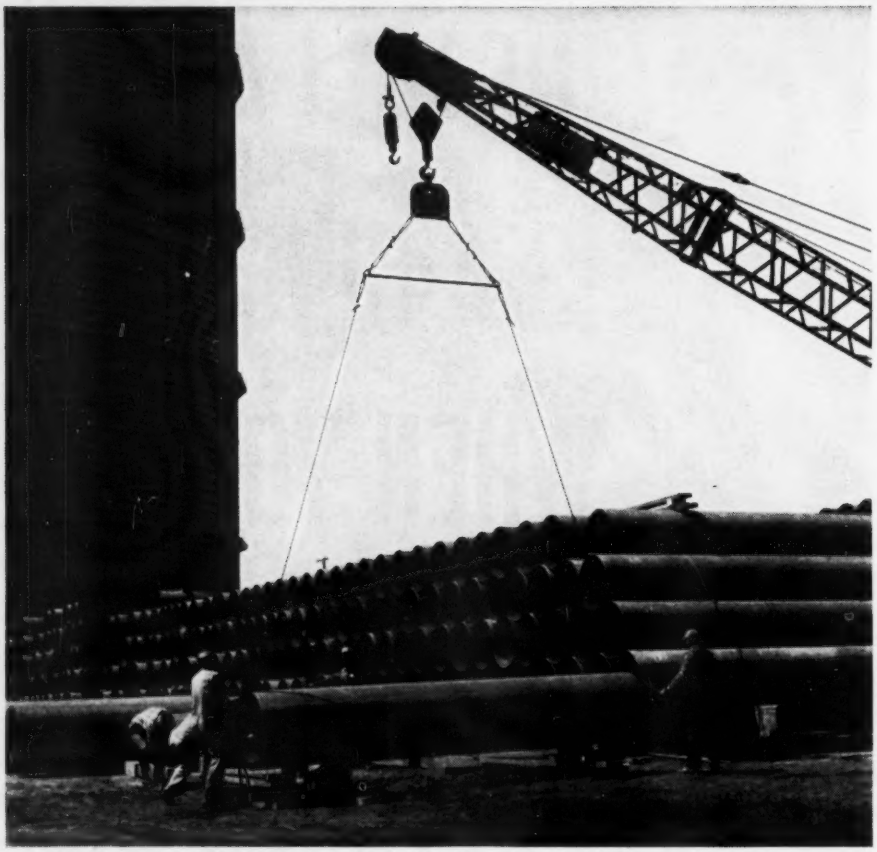
And tough cast iron pipe construction offers service-free dependability for years. Once in place, cast iron pipe stays there. In fact, 62 American cities are still using cast iron gas mains that were installed over a century ago.

CAST IRON PIPE RESEARCH ASSOCIATION,
Thos. F. Wolfe, Managing Director,
3440 Prudential Plaza, Chicago 1, Illinois

CAST IRON PIPE
THE MARK OF THE 100-YEAR PIPE

DISTRIBUTION DEVELOPMENTS

NEWS ABOUT CURRENT AND PLANNED CONSTRUCTION



Pipe — Tons of it! Workmen unload 36-in. steel pipe for the 1960 phase of Peoples Gas Light and Coke Company's interstation main now under construction *(See May AGJ)*. The pipe is being coated and stored at the company's Throop Street station.

Northern Ontario Natural Gas Co., Toronto, Ontario, Canada, has completed a 6.5 mile 6-in. main extension to connect a new industrial gas customer, Falconbridge Nickel Mines Limited. Initially, Falconbridge will use 2000 Mcf daily to fire two boilers and 5 sintering machines used in smelting process. In another project, Dome Mines Limited gold-producing mine in The Porcupine has converted from coal to natural gas for plant heating. Approximately 8000 ft of 4-in. line was installed to connect the plant with Northern Ontario's main line. The new line is also big enough to service School Section No. 2 located at Dome, and supply 125 homes at Dome and Dome Extension. A pressure reducing station is being constructed a short distance from the main office of the mine to reduce gas pressure from 600 to 65 psi. Further reduction to 6 psi is made at the automatic fire tube boilers.

Union Gas Company, Chatham, Ontario, Canada, is installing approximately 300 meters and regulators and an indeterminate amount of reinforcements of its distribution system in Guelph, Ontario. In another project, approximately 3 miles of 4 and 8-in. main are being installed in Galt, Ontario. Contractor for both projects is Majestic Contractors, Ltd., Toronto.

Commonwealth Natural Gas Corporation, Richmond, Virginia, parent company of **Portsmouth (Va.) Gas Co.** and **Commonwealth Gas Distribution Corp.,** reports its 1960 construction program is progressing on schedule. An 8-in. lateral and James River crossing are more than half completed and work on paralleling the main 18-in. supply line from Gum Springs west to Boswell's Tavern is well under way. Contractor is Latex Construction Co. Both projects will be completed in time for service during the 1960-61 heating season.

Anchorage Natural Gas Corporation, Anchorage, Alaska, has construction underway on its new distribution system. (AGJ Aug. 1960.) Ditching and pipe laying have begun along Karluk Street and also along Fireweek Street. The area to get first natural gas service is bounded by "H" and Nelchina Streets and Second and Fifteenth Avenues, the original townsite. In this section are approximately 1600 potential business and residential customers.

Ohio Fuel Gas Company, Columbus, Ohio, has construction underway on a $1,038,000 project to complete a high and medium pressure belt system in the Greater Toledo area. Project includes installation of 9,900 ft of 20-in. line in East Toledo, estimated to cost approximately $320,000, which will extend from Navarre and Holland Streets to the Maumee underriver crossing near Front and Euclid Streets. The line will come in Holland to Starr, to Belt to Kelsey, to Morrison, to Fourth to Euclid to Front where it connects with the existing O-F line. New regulator station will be installed near Bales and Laskey Roads and 1000 ft of 16-in. line laid to connect with the belt system in that area. An additional 119 ft of 12 in. line will be put in to serve a new regulator at Laskey Road and Monroe Street, and in Byrne Road to serve a regulator at Richards Road and Dorr Street. Another part of the project, estimated to cost $640,000 will be a line along the Holland-Sylvania Road to connect to an existing line in Maumee. Project includes installation of 33,000 ft of 24-in. from Nebraska Avenue along Holland-Sylvania Road to connect with the existing supply line in Maumee. Also to be installed in the Sylvania area are 3 new regulators and 8190 ft of lines to serve these regulators.

Company plans to spend $35,000 for 2 miles of 5 and 8-in. line to improve natural gas service in Sheffield Lake. To be completed by October, the new line will extend east along Oster Road from an existing line at Elyria Sheffield Road to Lincoln Boulevard, north along Lincoln to Ivanhoe Avenue, and eastward to near Irving Park Boulevard. Burkhardt Construction Co. is contractor.

Company crews have construction underway on a $14,000 project to improve natural gas service to Williamsport in Pickaway County. Approximately 5500 ft of 4½-in pipe will be installed to replace 2⅜-in. pipe.

One of many compact, safe and reliable gas control installations

This modern station incorporates Type "CBV-202" High Pressure, Offset Connected, Pilot Loaded Reducing Regulators. Outlet pressures from 1 to 300 psi. Available in 2 to 12-inch sizes with inlet pressures to 1000 psi. ■ Type "ZB" High Pressure Pilot Regulators for inlet pressures to 1000 psi and outlet pressures from 2 to 225 psi. ■ Type "A" Filters for pressures to 1000 psi. ■ For any gas system, RELIANCE EQUIPMENT provides reliable control and maximum safety. ■ *Write for bulletins containing complete specifications.*

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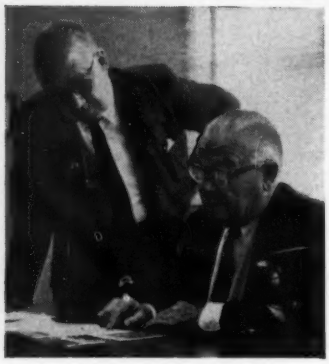

President Baird checks on final shipment.

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Distribution Developments

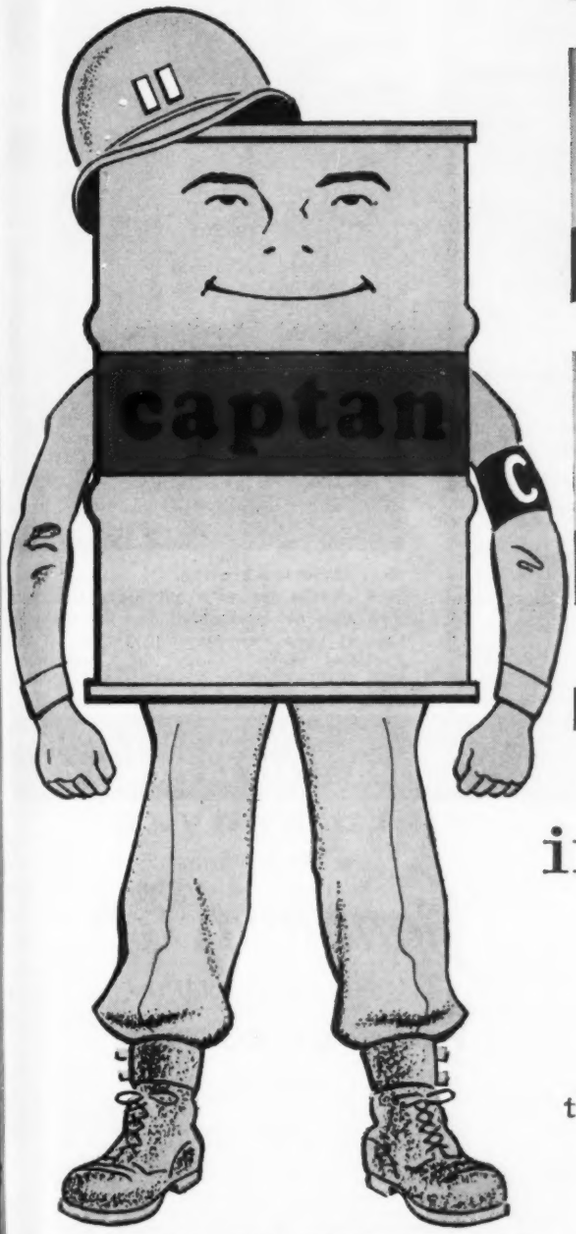
Iowa Electric Light and Power Company, Cedar Rapids, Iowa, has completed construction on new distribution systems in Tama and Traer thus reducing the number of distribution systems authorized and yet to be installed to 9. Others installed this year were George, Sibley, and Ashton.

Saskatchewan Power Company, Regina, Saskatchewan, Canada, has completed two more distribution systems in Pense and Riceton, bringing the total completed to 12 of the 22 centers included in SPC's 1960 program. Distribution systems have been laid at Indian Head, Lang, and Wolseley, but services have not been completed. At Nipawin and Carrot River, mains have been completed and crews are working on service pipes. Crews are also working on Greenfell, Broadview, Midale, Stroughton and Assiniboia systems. Contract for the 70-mile supply line between Parkbeg and Assiniboia has been awarded to Robb Construction Co. Ltd., Regina, at a cost of $180,000.

SPC has added 3618 new customers in the first 5 months of 1960 upping the total number of customers to 62,955 as against 59,337 at the end of 1959.

Southern Union Gas Company, Dallas, Texas, has construction underway on a project to serve a new housing development at Hoffman City, New Mexico, near Albuquerque. Project includes installation of 6300 ft of 8-in., 4140 ft of 6-in. and 3363 ft of 4-in. pipe. Mermis Construction Co. of Albuquerque is the contractor. Hallmac Construction Co. of Houston, Texas, recently completed installation of 15,000 ft of 16-in. line to serve the municipal power plants in Austin. Another project recently completed was four miles of 2 and ⅜-in. line to serve portions of Yavapai County, Arizona, north of Chino Valley, with natural gas for irrigation pumps.

Six and one-half miles of 8-in. line has been installed to Pan American's Empire Abo plant near Artesia to receive 10,000 Mcf daily for distribution to Southern Union customers in Artesia, Roswell, and Carlsbad areas. Ferguson Construction Co. of Eunice is contractor. On the outskirts of Carlsbad approximately 22,140 ft of 6-in. is being moved 75 ft from one private right-of-way as a result of enlargement of 2-lane highway to four lanes. Construction began in July. Another project currently underway involves replacement of 10,000 ft of 4-in. main line in Santa Fe. Mermis Construction Co. of Artesia is contractor.



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Western Canada

Walt Fitzgerald
North East

Chauncey Robinson
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Charlie Hall
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SOUTHERN CROSS

(SCF) FORESTERS

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Atlanta Gas Light Company, Atlanta, Georgia, is ahead of schedule on construction of its 1960 $1,500,000 expansion of the Riverdale refrigerated peak-shaving plant. *(AGJ Mar. '60.)* Foundations for both 1,290,000-gal capacity storage tanks have been completed and sections of the tanks are being put into place. One tank is scheduled to be filled with propane in September, and the other in October.

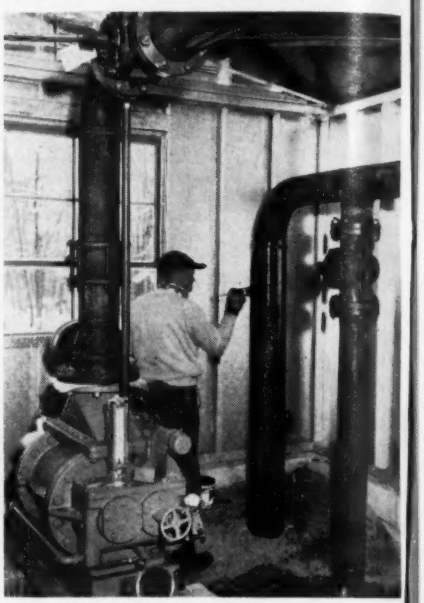
Washington Natural Gas Company, Seattle, Washington, plans to extend gas service to Redmond and Des Moines. Project involves installation of 57,400 ft of main to initially serve several hundred homes and many commercial establishments. Another contract scheduled for fall completion is installation of 548 gas heating appliances to 512 additional units in a large housing project.

Indiana Natural Gas Corporation, a newly-formed company with headquarters in Paoli, Indiana, has completed distribution systems in Paoli and Orleans. Supplier is Texas Gas Transmission Co.

Arkansas Louisiana Gas Company, Shreveport, Louisiana, and four villages in Arkansas River Valley have applied to the Arkansas Public Service Commission for permission to operate a pact whereby the towns will install

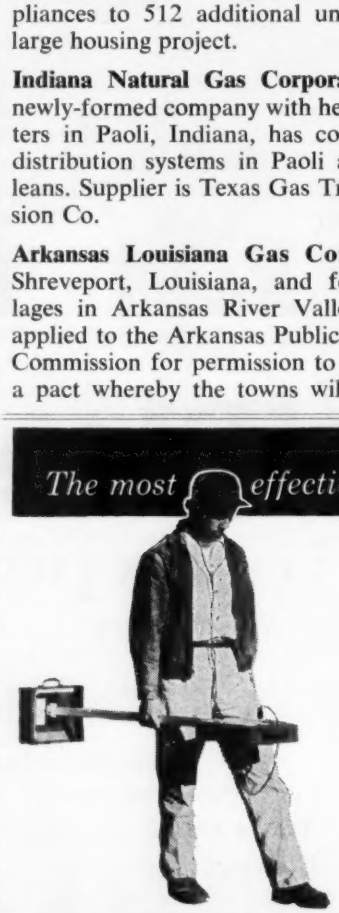
Distribution

distribution systems and Arkansas Louisiana will lease the units with an option to buy. Bonds floated to finance the installations are Humphrey, $99,000; Redfield, $84,000; Sherrill, $159,000; and Wabbaseka, $109,000.



New Metering Station. Orange and Rockland Utilities, Inc. of Nyack has maintenance man George Derbyshire put the finishing touches on a new metering station at the Rockland State Hospital in Orangeburg, New York.

The most effective PIPE LOCATOR in the world



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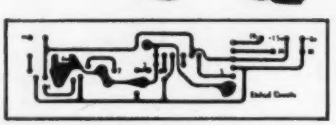
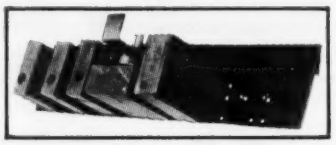


ETCHED CIRCUITRY



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Developments

Western Gas Fuel Company plans to build new distribution systems at Chadron, Crawford, Hay Springs, Hemingford, Gordon, and Rushville, Nebraska. Kansas-Nebraska will be the supplier under temporary FPC authorization issued July 18 to extend K-N's transmission system in northwestern Nebraska to deliver gas wholesale to Western Gas Fuel.

Northwest Natural Gas Company, Portland, Oregon, is converting customers' appliances in the Eugene-Springfield area from propane-air to natural gas in anticipation of completion of El Paso Natural Gas Co.'s 121 mile transmission line from Camas, Washington, up the Williamette Valley in Oregon to the Eugene-Springfield area. *(AGJ April '60.)* Construction of the major portion of gate stations and connecting tie-in lines is well underway. Town crews of contractor, Hood-River Associates, are currently working in congested area near Portland. Northwest already has entered into contracts for sale of substantial volumes of gas to 7 industrial customers.

Pennsylvania Gas Company, Warren, Pennsylvania, received FPC authorization July 21 to activate and operate the Summit gas field in Erie County, Pa., as an underground natural gas storage field. The company, a subsidiary of National Fuel Gas Co. of New York, will recondition 46 wells, plug 10 wells, and install a 440-hp compressor unit at an estimated cost of about $1,186,-288. The storage field will help Pennsylvania Gas meet increasing demand of its customers for additional space heating gas.

Backfilling a main that will service a new housing development near El Cajon, California, is fast and easy work for this tractor-shovel equipped with a special "4-in-1" bucket. Tractor-shovel unit is one of a fleet used by San Diego Gas and Electric Co. for construction and maintenance work in its vast service area in Southern California.

All-New, Compact Size

Model H-30 PAYLOADER®

WITH 3000-LB. OPERATING CAPACITY, the Model H-30 is the smallest "PAYLOADER" tractor-shovel ever made with 4-wheel drive. It is available with 1-cu. yd. bucket and a 77½-h.p. gas engine. At maximum height, clearance under the bucket edge (dumped) is 8'4" and reach ahead of the front tires is 29". In spite of its compact size and modest price, the H-30 has the latest improvements of larger "PAYLOADER" units that provide operating advantages not found in any comparable machine:

Four-Wheel Brakes: Powerful hydraulic type, sealed to keep out dust and dirt.

Full Power-Shift Transmission plus torque converter: Three speeds in each direction. All shifts made "on-the-go." No foot clutching.

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Visibility and Safety: New slope-down front end lets operator see bucket-loading action. Safety boom arms keep all moving parts ahead of operator. Fixed ladder and hand rails standard.

Positive Oil Cooling: Separate fan-cooled oil-to-air radiator assures positive cooling of transmission and torque-converter oil.

"Operator's Choice" Brake Pedals: Dual pedals give the operator a choice of braking with or without transmission engaged.

Maximum Accessibility: Fuel tank and transmission can be checked and filled from ground level. Easy access to battery, engine and other necessary points.

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7-B-6

Distribution Developments

The Gas Service Company, Kansas City, Missouri, has secured a gas franchise in Seneca, Missouri, near Oklahoma state line at junction of highways 60 and 43. Plans to install a new distribution system to serve approximately 1500 citizens are dependent on approval of Missouri PSC and FPC approval of a gas supply from Cities Service Gas Co. Company is also seeking gas franchise in Ozark, Missouri, 19 miles south of Springfield.

Laclede Gas Company, St. Louis, Missouri, has completed replacement of 4450 ft of 24-in. cast iron main with a 20-in. steel pipe on Goodfellow Boulevard north of Natural Bridge. Because the street was adjacent to a government small arms plant and had been laid with extra-heavy concrete to government specification, the new gas line had to be laid beneath a sidewalk that covered all right-of-way to the street and the company had to replace the sidewalk.

Approximately 15,000 notices giving permission to install gas heating have been mailed to customers since March. Remaining in the file are approximately 16,500 applications for conversion to gas heating, and additional applications continue to be received at rate of 225 per week. To meet the growing demand Laclede has requested 42.5 million cu ft of gas daily by 1965, subject to approval by the FPC, from a new pipeline connecting St. Louis with Trunkline Gas Co. at Johnsonville, Illinois, about 90 miles east of St. Louis. The connecting line is to be owned and operated by Mississippi River Transmission Corp., a subsidiary of Mississippi River Fuel. The new subsidiary also plans to develop an underground storage field in the St. Jacob area of Illinois, 30 miles east of St. Louis, to be used similarly to Laclede's Florissant storage field.

Cincinnati Gas & Electric Company, Cincinnati, Ohio, plans a $1,500,000 gas service extension in its eastern division. Franchises have been obtained, or are being sought, in the villages of Mason, Oxford, Millville, Terrace Park, Milford, Cleves, and North Bend. A new 5-mile supply line to Milford will be complete by late September and will make natural gas available to Milford Shopping Center and the Indian Knolls subdivision. The new line will run from CG&E's present system at Roundbottom and Broadwell Roads, cross the Little Miami River near that point, run through Terrace Park and cross the Little Miami again just below the Milford bridge.

Washington Gas Light Company, Washington, D. C., plans to spend approximately $17,600,000 for new construction in 1960. Currently company is seeking FPC permit to spend $3,770,000 to construct 15.8 miles of 24-in. line from Hybla Valley, Virginia, across the Potomac river to near Palmer's Corner, Maryland. The river crossing will be dual 24-in. lines, each 13 miles long.

Central Missouri Gas Company, Jefferson City, Missouri, has construction underway on a new distribution system in Kirksville, Missouri, and plans to complete similar systems in Queen City, Lancaster and Greentop at an estimated initial cost of $1,790,625. Contractor on the Kirksville distribution system is Panama-Williams Corp. Michigan-Wisconsin Gas Co. is the supplier under a July 14 FPC authorization.

Kansas Power & Light Company, Salina, Kansas, has construction underway on two projects in Salina — one, 4,100 ft of 4-in. intermediate pressure main to serve an industrial development; the other, 2,550 ft of 4-in. and 1,920 ft of 2-in. intermediate pressure main to serve suburban developments. Contractor on the projects is M. E. White Construction Company, Inc.

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QUALITY...CORROSION CONTROL

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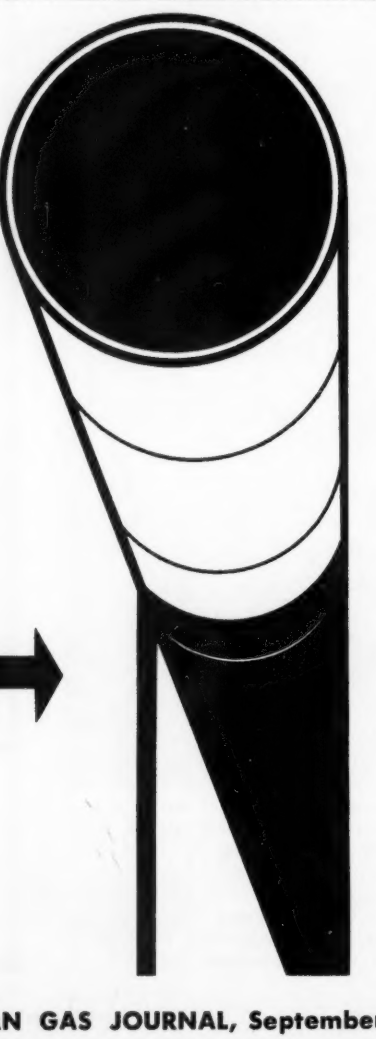

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Did You Miss These?

Make a quick check of this list of important research bulletins published this year . . . you'll need 'em for your reference file. *All are available from the American Gas Association, 420 Lexington Avenue, New York 17, N. Y.*

Infra-red energy—its uses and applications. List of present and future possible applications of infra-red heat along with an evaluation of available literature on the production of infra-red energy by both gas and other means is presented in new research bulletin. Physics and mathematics of radiant heat transmission are given in a brief and simple manner; the different types of gas-fired infra-red burners are described and compared to electrical infra-red generators.

"Literature Review of Infra-Red Energy Produced With Gas Burners," *A.G.A. Laboratories Research Bulletin 83. Price, $2.*

Better Burner for water heaters. Research bulletin bridges gap between previous publications on burner design and the current burner applications in water heaters. Performance of various burners in several types of water heater combustion chambers are compared to those same characteristics observed under open room conditions.

"Flame Characteristics of Gas Storage, Water Heater Burners," *A.G.A. Laboratories Research Bulletin 82. Price, $2.*

How To Bake a Better Bun F-a-s-t-e-r. Experimental Polythermic gas deck oven that produces most baked foods in half the time needed with conventional deck ovens, is described in new research bulletin. With development of this commercial gas equipment it will be possible to obtain a higher ratio of food production per man hour of skilled labor.

"High Speed Deck Oven Design and Baking Studies, Part I: The Polythermic Oven," *A.G.A. Laboratories Research Bulletin 81. Price, $2.*

Future Load Builder? Field testing and evaluation of the newly-developed high performance range top burner by 8 gas distribution utilization and home service departments is described in new bulletin. Field study was conducted as part of PAR project for development of an improved domestic gas range.

"Gas Company Experiences with Experimental High Performance Burner," *A.G.A. Laboratories Research Bulletin 80. Price, $2.*

Plenty of Hot Water. Pointing the way to an abundant supply of hot water in the customer's home is A.G.A.'s new research report that describes an experimental 30-gal, table-top water heater that operates at a heat input rate of 40,000 Btu per hour. Results of a 3-year study of 2 experimental 60,000 Btu per hour, 30-gal storage water heaters indicate corrosion of the storage tanks with such high heat input rate need not be any greater than that for a contemporary unit of comparable size with a heat input rate of 30,000 Btu per hour, provided the unit is properly designed.

"Design and Performance Characteristics of High Recovery Gas Storage Water Heaters," *A.G.A. Laboratories Research Report No. 1311. Price, $1.*

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THE CLEVELAND JS-30 TRENCHER, with instant lateral shifting and power tilting of its digging wheel, got high daily trench production on a utility job where trench had to be dug in a road shoulder hemmed in by poles, trees and heavy growth on side slopes rising sharply within six feet of the pavement's edge.

Crawlers were steered as necessary to sneak by obstructions, while the JS-30's digging wheel was power-shifted laterally, keeping trench digging right on line. Power-tilting of its digging wheel allowed the JS-30 to dig straight vertical trench with one track higher than the other on the side slopes, without blocking or cribbing.

THE JS-30—A TRENCHER OF AMAZING UTILITY

- Digging wheel power-shifts 5' from side to side
- Digs trench flush with parallel pavement, curbs, etc.
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- Digs vertical trench on side slopes, cuts blocking, cribbing
- Excavates bell holes, saves on trench width
- Digs 11"-24" wide, to 5½' deep; digs to 6' wide with power-shifting of wheel
- 100% control of all operations at operator seat.

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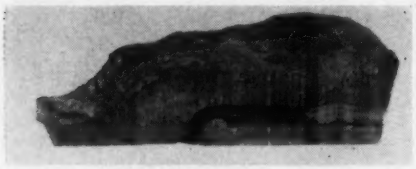
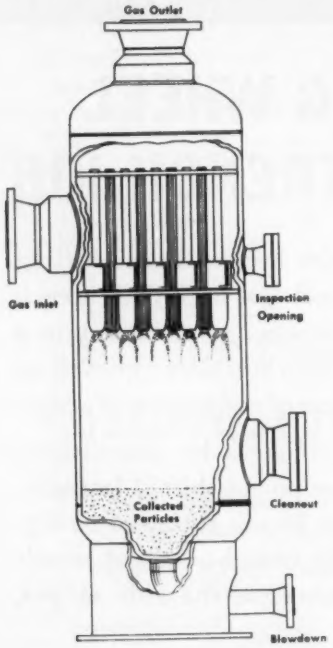


Sealant for cast-iron gas mains . . . new internal sealant ends gas leakage in bell-and spigot joints, and permits increased operating pressures for greater flow through existing systems. Con-Seal, made by West Chester Chemical Co., combines best features of rehydration, chemical additives, and mechanical seals in a single material. Like rehydration and additives, it permeates and swells jute fibers packed under joint caulking. Then material polymerizes, or self-cures, to join particles chemically into tightly-bonded resilient mass.

CIRCLE (1) ON THE REPLY CARD



Scrubber . . . new line of dry scrubbers removes dust and liquid from gas lines using multiple small diameter cyclones arranged in parallel. The cyclone elements —2-in. in diameter—are constructed of an alloy that combines abrasion and corrosion resistance with shock resistant qualities needed for reciprocating compressor station requirements. Peerless Mfg. Co.'s new scrubbers are available in complete range of sizes and working pressures to fit any scrubber requirement.

CIRCLE (2) ON THE REPLY CARD

Napoleon's Gun Barrels . . . New sound-color 16 mm movie from Fisher Governor Co. illustrates emergence and growth of gas industry from its primitive beginnings. Describes types and construction of regulators used on city gate stations, farm taps, district stations, industrial gas use, and house service. Has running time of 28 minutes; is available for showings to industry and educational groups.

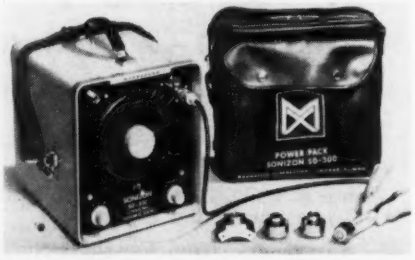
CIRCLE (3) ON THE REPLY CARD

Radiant furnace . . . Blaw Knox Company's new unit for rapid precision heating of heat-sensitive materials has such low heat capacity it can be brought from a cold start to full heat in less than 5 minutes. Basic furnace design consisting of a light stainless steel shell surrounded by light-weight, high-temperature insulating material allows a rapid flow of radiant heat into the kettle or autoclave without development of local hot spots. Approximately 75 percent of heat applied to the batch is by radiation from the furnace walls. Operating costs are considerably less than those of a conventional brick-lined furnace, chiefly because of the inherently low heat capacity.

CIRCLE (4) ON THE REPLY CARD

Integrated computer control system . . . Brain of Minneapolis Honeywell's integrated computer control system is a general purpose all-solid-state digital computer—the Honeywell 290—that can perform 8,000 additions or subtractions, 1250 multiplications or 400 square root extractions per second. For gas dispatching on-line monitoring and control, computer's high-speed operation permits frequent system checks and closer control of variables; and enables computer to do other jobs on time-sharing basis. Also provides for future increases in scope and complexity of operations. Other features include parallel operation, random access, magnetic core and auxiliary magnetic drum memory, and special instruction vocabulary.

CIRCLE (5) ON THE REPLY CARD



Pipe walls measured ultrasonically . . . Transistorized battery-operated ultrasonic instrument measures wall thickness between .025 and 2.50 inches. Suggested for detecting corrosion or wear in tanks or pipelines. Magnaflux Corporation's new portable unit gives instantaneous readings by simply placing transducer on surface to be measured and turning a dial. Unit measures with accuracy of plus or minus 1 percent when calibration is checked during tests against known samples of the same material.

CIRCLE (6) ON THE REPLY CARD

Services for the gas industry . . . including feasibility studies, system planning, design and construction, operating practices, and management reports — offered by Ebasco Services, Inc., are explained concisely and completely in a colorful new 6-page brochure available to all engineering, operating, and management personnel in the gas industry.

CIRCLE (7) ON THE REPLY CARD

Closed circuit TV . . . and what every businessman should know about it . . . is subject of 9-page brochure from GPL Div. of General Precision, Inc. Industrial and commercial television is explained in layman's language.

CIRCLE (8) ON THE REPLY CARD

Aluminumcase meters . . . and their applications . . . are described in four new bulletins from American Meter Co. Covered are the 175- and 250-cfh capacity meters rated at 5 psi maximum working pressure for normal domestic service; the 800-cfh, 20 psi working pressure model for medium size commercial and industrial loads; the 110-cfh-propane, 5 psi working pressure model for medium size homes; and the 225-cfh, 5 psi working pressure model for household heating loads.

CIRCLE (9) ON THE REPLY CARD

Pipe . . . specifications and other facts about line pipe produced by Youngstown Sheet and Tube are outlined in new brochure. Three methods of manufacture — continuous weld, seamless and electric weld—are also described graphically.

CIRCLE (10) ON THE REPLY CARD

Fittings and flanges . . . for lightweight piping are described in Tube Turns' revised bulletin TT942. Dimensions for lightweight welding fittings in ¾ to 24-in. nominal pipe sizes and the 125-lb forged steel lightweight taper-face welding neck flanges are given.

CIRCLE (11) ON THE REPLY CARD

Computer language . . . the baffling technical jargon surrounding "electronic brains" . . . is defined in new pocket-size 22-page glossary available from Brown Instruments Division of Minneapolis-Honeywell Regulator Co. More than 82 terms—including binary coded decimal, mnemonic code, binary digit, drum, address, and bit—are explained in simple terms.

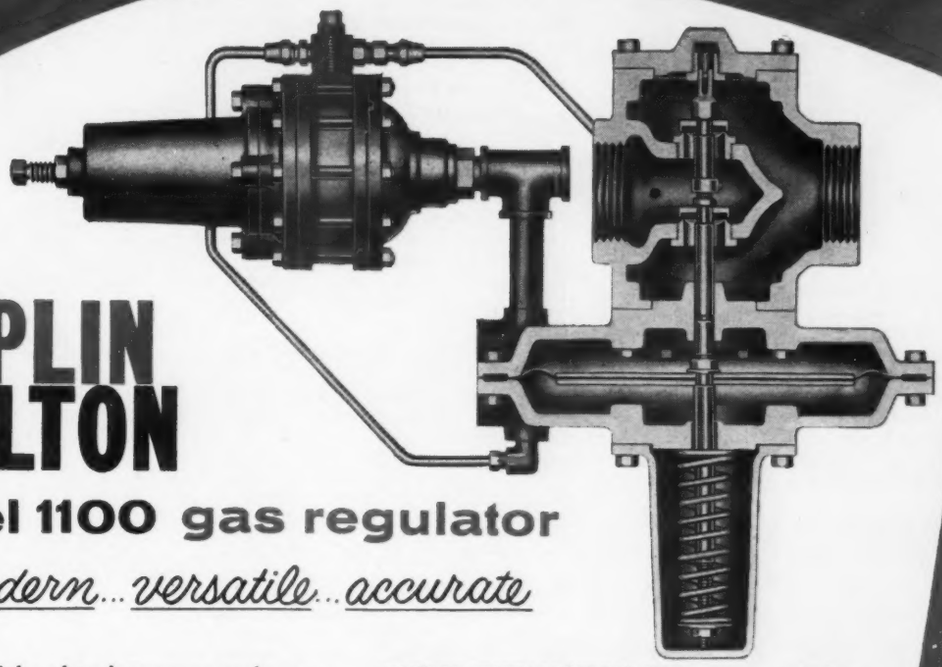
CIRCLE (12) ON THE REPLY CARD

Marketing kit and promotion portfolio . . . for gas companies and appliance dealers using the "Speedy Therm" symbol catalogs dozens of items available to service subscribers . . . gives non-subscribers an opportunity to inspect complete advertising, merchandising, and public relations materials promoting gas usage and gas appliances. "Gas Works Best for You" is central theme of new kit. Highlighting new material available are animated television commercial, and wide range of premiums, prizes, and gifts based on the Speedy Therm character.

CIRCLE (13) ON THE REPLY CARD

Gas cocks . . . iron body brass core type . . . can be supplied with insulated union that is integral with tailpiece of union and cannot be lost or left out. This insulation will not shear off, pull out, or crack in service.

CIRCLE (14) ON THE REPLY CARD



CHAPLIN FULTON

model 1100 gas regulator

modern... versatile... accurate

You can't buy, beg, borrow or steal a more versatile pressure regulator than MODEL 1100. Nor has traditional Chaplin-Fulton ruggedness, simplicity or accuracy been forgotten in this new modern design. Size —2" only, screwed, flanged 125 or 250 ASA.

WIDER APPLICATION Inlet Max.—400 psi. Outlet Range—1" to 150 psi.

GREATER CAPACITY 24,000 cfh at 10 psi to ounces; 114,000 at 100 psi. Body contoured for flow.

EASIER MAINTENANCE Regulator or pilot can be serviced without disturbing the other. Quickly accessible orifices in both, easily renewable.

SIMPLER INSTALLATION Only one connection required. No complicated pins or toggles to adjust.

You can standardize on MODEL 1100 for a wider range of your industrial, commercial or distribution installations.

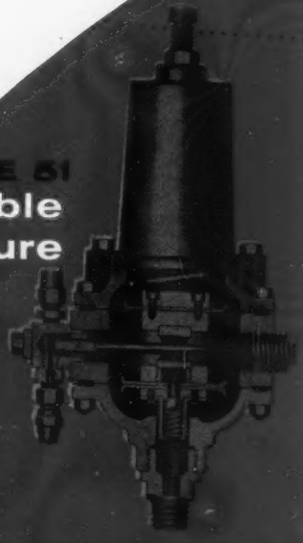
ACCURATE CF MFG CO. DEPENDABLE

Write for bulletin 1100

Chaplin-Fulton

MANUFACTURING COMPANY

Pittsburgh 25, Pennsylvania



TYPE 51 variable pressure pilot

The heart of the MODEL 1100 assembly, insuring precisely accurate control over the complete flow range.

- Unitized construction—valve lever and orifice as a unit are removed from the outside, without disturbing balance of assembly. The likely trouble spot—the orifice—is placed outside where you can get at it quickly—no internal tubes to clog.
- Twin diaphragms remove as a unit.
- Internal relief unit—guards against overpressure.
- Spring unit—remove three screws to change springs.
- Built for service.
- Used for accuracy.

Backhoe . . . New model combines high flotation on 14-in.-wide tires, off-highway maneuverability, and 59 mph job-to-job travel speeds. Four-wheel drive, power-steer, and heavy-duty chassis all contribute to successful operation in rough or mucky terrain. Digs 13½ ft deep, reaches 20 ft from pivot, swings 200 deg., and has full-bucket dump clearance of 11½ ft. Hoe attachment is also available for mounting on new or used 2-ton truck of "standard" design.

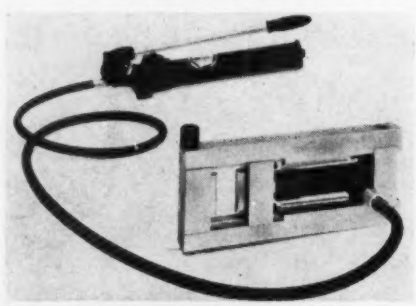
CIRCLE (15) ON THE REPLY CARD

Fork lift truck . . . Loads of 4000 lb are handled by Ford Motor Co.'s new fork lift, first lift truck to bear the Ford name. New unit is available in 10, 12, 16, and 21-ft stacking heights, and with choice of diesel or gasoline engines. High flotation pneumatic tires enable it to move materials over extremely rough or wet ground.

CIRCLE (16) ON THE REPLY CARD

Locates underground shorts on mains and service lines. New method for locating underground electrical shorts on a coated main has been developed using Tinker and Rasor Pearson-type equipment. A 5 to 10 watt current of audio frequency is applied directly to the line; the resulting electrical field can then be intercepted and measured with an inductance coil and easily followed to the point of a foreign electrical contact. Since the electrical field is sharply dislocated at the location of the foreign contact, such shorts are pinpointed within inches.

CIRCLE (17) ON THE REPLY CARD



New hydraulic pinch-off tool . . . for up to ¾-in. diameter copper tubing produces a hermetically perfect cold weld seal. The 4-ton hydraulic ram may be hand or foot operated; an electrically operated model is also available. Ideal for difficult access situations. Unit is easy to operate, can be used by unskilled personnel, and may be transported easily from one work site to another.

CIRCLE (18) ON THE REPLY CARD

Gas infra-red heating . . . its economic advantages, control arrangements, and design data . . . are explained in 4-page brochure available from Perfection Div. of Hupp Corporation. Tables of mounting heights for different models and recommended minimum clearances from combustibles are given.

CIRCLE (19) ON THE REPLY CARD

Plastic pipe insert lead plug . . . for inserting and leading Kraloy PVC plastic pipe through old pipe in service renewals . . . is subject of new literature. Screw tightened rubber expander holds lead plug firmly in pipe. Plug is described as equally efficient in pushing plastic pipe through holes bored with auger through ground under sidewalks, driveways, etc.

CIRCLE (20) ON THE REPLY CARD

Contractors, utilities, municipalities . . . will want to send for new 6-page catalog describing Arps Model MA-2 Trench Devil . . . a one-man operated trencher with 5 digging widths down to 54 in. deep. Digging speed is variable from 0 to 1200 ft per hour.

CIRCLE (21) ON THE REPLY CARD

How to minimize pipe leak repair clamp inventory . . . using Smith-Blair sta-grid gasket . . . is suggested in new 3-color folder. The gridded neoprene, backed with 26-gage stainless steel, can be cut to any length and then secured by as many Smith-Blair redi-clamps as required . . . thus reducing the considerable multi-size clamps inventory investment previously necessary.

CIRCLE (22) ON THE REPLY CARD

Advantages of gas . . . and the disadvantages of electricity are pointed out in attractive 2-color, 8-page folder produced by Southern Gas Association. Challenge of electric heating systems is met squarely from outset; folder speaks out against expensive and inefficient "hot wire" or heat pump systems and "thermos bottle" insulation. Write for a sample copy.

CIRCLE (23) ON THE REPLY CARD

Small, compact, tough trencher for city and suburban work is described in new 12-page folder from Cleveland Trencher Co. Photographs illustrate special design and construction features of new Model 92 "baby digger." Dimensions and specifications are also included.

CIRCLE (24) ON THE REPLY CARD

Packaged blowers . . . to match Reznor's gas-fired duct furnaces are described in new 4-page specification bulletin. Performance data tables aid in selection of drives and motor sizes for handling air quantities from 2,000 to 6,000 cfm with the K1 blower, and from 4,000 to 12,000 cfm with K2 blower.

CIRCLE (25) ON THE REPLY CARD

Gate valve . . . Lunkenheimer's new union bonnet bronze gate valve available in sizes ¼ to 2-in. . . . is described in 4-page circular. Sectional views detail features of new valve that has double wedge disc and rising stem; valve is rated at 200 lb W.O.G.

CIRCLE (26) ON THE REPLY CARD

Seamless welding fittings . . . latest addition to Midwest Piping Co.'s line of welded-type fittings . . . are described in new 12-page illustrated bulletin, which also gives size ranges and applications on Midwest standard fittings.

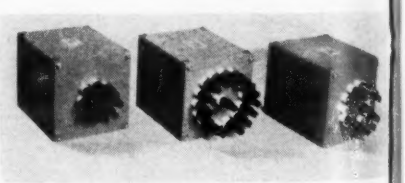
CIRCLE (27) ON THE REPLY CARD

Gas Line Probe . . . Impacto Tools' new "Super 30" gas line probe is made for one man operation. Can be used with explosion test meter. Test can be completed before tool is removed from soil. Unit penetrates to 30 inches; impact does the work. Manufacturer claims unit is only repairable parts probe on market. All parts are precision made.

CIRCLE (28) ON THE REPLY CARD

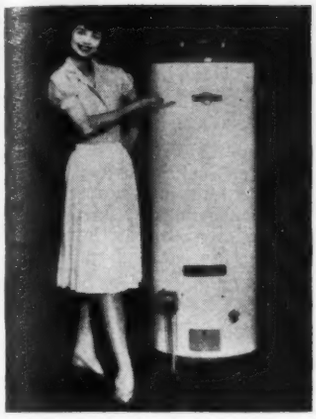
Latest addition to McCabe-Powers line of gas construction and maintenance bodies can handle both routine and emergency jobs. It carries all tools needed for gas line work—pneumatic pavement breakers and tampers, welding equipment, solvents, lanterns, barricades and other tools—in special compartments and in the 51 by 96-in. body cargo area. Air compressor can be installed between truck cab and body head panel or mounted in the body proper and accessible by removable panels. Other optional equipment available includes compact, winch-type air hoist to handle lifting and dragging jobs as well as towing of backfill scraper; an air-hose reel that is installed in the curb-side rear compartment, and a water pump that mounts forward of the truck radiator.

CIRCLE (29) ON THE REPLY CARD



Automatic igniter control . . . Protection Controls, Inc., has developed a multi-burner igniter control, called the *Ignitifier,* for automatically firing-up a network of gas burners in ovens, furnaces, boilers, and heat treating systems. Can fire up 32 burners in 3 seconds. Positive contact-wiper switching design eliminates arcing gap and wasted energy. Special timing unit can also be incorporated to active motor at any desired intervals for continuous, intermittent, or variable timed ignition. Available in capacities of 8, 12, 16, 20, 24, 28 and 32.

CIRCLE (30) ON THE REPLY CARD



Load builder . . . Hotstream's new 40-gal. gas water heater has recovery capacity of over 1 gallon of hot water per minute—127 percent higher capacity than conventional heaters of the same size. New concepts in design have been instrumental in boosting recovery capacity. Combination internal-external flue construction provides greater exposure of heat transfer surface area—460 percent more than internal flue heaters, 13 percent more than external flue heaters. Specially designed, low contour, 3-in. high draft hood eliminated need for 14-in. draft hood normally required in heaters of such capacity. Heater stands 64 inches high. Combination thermostat-automatic safety pilot thermocouple-type control provides easily adjustable settings and shuts off all gas supply in event of pilot flame failure.

CIRCLE (31) ON THE REPLY CARD

Meters, controls . . . Capsule information about many B-I-F Industries products and systems is now available in new 8-page general bulletin. Butterfly valves, supervisory controls systems, totalizing meters, flow meters, and process instrumentation are covered.

CIRCLE (32) ON THE REPLY CARD

Telephone answering service for computers. New data processing device that answers the telephone and takes messages in the form of punched cards is IBM's latest. Known as the 1001, unit consists of one or more sending stations linked to a central receiving station by dial telephone lines at regular toll rates or by leased telephone lines. Used with telephone company service such as the Data-Phone, new system transmits both fixed data from pre-punched cards and variable information keyed in manually on a keyboard. Receiving station accepts data, simultaneously punching it into cards which are then ready for processing by a computer or accounting machine. Possible applications include centralized inventory control, payroll, and branch office public utility cash reporting.

CIRCLE (33) ON THE REPLY CARD

Alarm-control system . . . providing inexpensive method of locating faults at unattended remote operations and controlling "on-off" functions remotely . . . is described in bulletin from General Electric Communications Products Dept.

CIRCLE (34) ON THE REPLY CARD

Removal of entrained hydrocarbons and organic liquids in gas lines is possible with Selas Corporation's new coalescer-demister. The new device utilizes a system of porous materials. Initially, entrained liquids in form of small droplets and mist are coalesced into larger size droplets and then are removed from the system. Standard units with capacities up to 7000 scfm at pressures up to 200 psig are available.

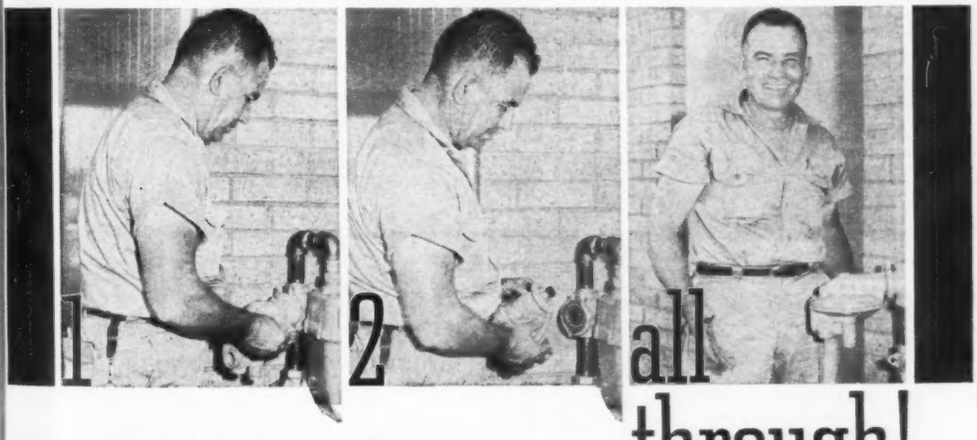
CIRCLE (35) ON THE REPLY CARD

New office device turns out typewritten and punched data on cards and on a tape simultaneously. IBM's new 870 system is suggested as valuable to companies that want the same or parts of the same data recorded in all three ways for filing and for long-distance transmission by telegraph. Equipment can be operated manually or will automatically reproduce information from a punched card or punched tape.

CIRCLE (36) ON THE REPLY CARD

Update your files on industrial tractors and equipment with latest 6-page bulletin from J. I. Case. Tractor-Shovels, power-angling dozers, power-tilting bulldozers, wheel loaders, fork lift, and interchangeable attachments are described.

CIRCLE (37) ON THE REPLY CARD



4 models: Standard no-seal; automatic cutoff; full capacity internal relief; internal relief and automatic cutoff combined.

Easy On! Easy Off!

REYNOLDS HOUSE SERVICE

8010 SERIES GAS REGULATOR

Inspection's a breeze with this versatile, popular Reynolds house service regulator. Exclusive V-band stainless steel coupling with a single screw allows simple 1-2-3 inspection as shown above: 1. Diaphragm case comes off easily. Valve body stays in line. 2. Valve disc and seat inspected. 3. All through! After screw quickly inserted in V-band clamp.

Now's the time to stock up on this fine house service gas regulator. For a look at our entire line, write for a free catalog.

GEM MEMBER

GAS CONTROL Since 1892

ARKLA

REYNOLDS GAS REGULATOR CO., INC., ANDERSON, INDIANA

A SUBSIDIARY OF ARKANSAS LOUISIANA GAS COMPANY

Industrial telemetering equipment . . . available from ASCOP Div. of Electro-Mechanical Research . . . is featured in new 8-page brochure. Typical line costs and line capacities as well as a description in simple terms of how the telemetering system works are given.

CIRCLE (38) ON THE REPLY CARD

Airless abrasive blast cleaning . . . for removing mill scale and other surface corrosion from pipe used in gas mains . . . is explained in 8-page bulletin from Wheelabrator Corp. Principles, equipment, and installations are discussed.

CIRCLE (39) ON THE REPLY CARD

Soil resistivity prod bar has replaceable head that permits it to outlast other prod bars up to five times longer. Agra Prod is a single bar, incorporating two electrodes, that will determine soil resistivity when used with proper instrument. Prod has ½-in. round section of very tough steel for all but bottom few inches of shank to permit easy entry into hardest of soils, including rocky soils, without impacting or hammering. Standard length is 44 inches. Shorter lengths, or lengths to 48 inches, can be furnished.

CIRCLE (40) ON THE REPLY CARD

Wet test meters . . . in capacities to 1200 cfh and 150 l/m . . . are subject of bulletin 501 from American Meter Co. Data on capacities, calibration, indexes, dimensions and special models available are included.

CIRCLE (41) ON THE REPLY CARD

Forged steel needle valves and fittings . . . for heavy duty service to 5000 psi such as many gas measurement and control applications require, are described in new bulletin from American Meter Co. Valves and fittings are also available in forged carbon steel and forged stainless steel.

CIRCLE (42) ON THE REPLY CARD

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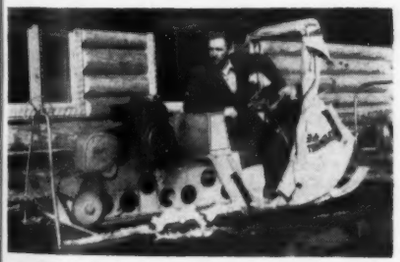
PRODUCT PARADE

Room thermostat . . . White-Rodgers Co.'s new D'Luxline thermostat for heating, cooling, and heating-cooling installations, has a level-bubble built into the wall mounting plate. This aids installing dealers in level-sure mounting and accurate calibration so necessary for top operating efficiency of thermostats that use a mercury switch. Setting is knob-type with a large easily read dial.

CIRCLE (43) ON THE REPLY CARD

First Futura gas model . . . Scheduled for production this fall, Geo. D. Roper's new 40-in. cabinet type gas built-in is designed to give maximum cooking capacity and greater convenience. Features include convenience level baking oven, separate thermostatically controlled broiling section with rotisserie, and four top burners, including a Tem-Trol automatic top burner, all controlled from panel located in front of unit below the burner top level. Tasteful design on oven and broiler doors helps conceal oven interiors while enhancing kitchen decor. Fluorescent light panel behind burners throws high illumination working light across entire cooking surface.

CIRCLE (44) ON THE REPLY CARD



Possible replacement for the dog team, the latest equipment for the northern-bound meter reader is Kohler Co.'s Alaskan "iron dog" or Sno-Traveler. The one-man snowmobile is powered by three engines—two 10-hp and a 7-hp—and designed to travel faster and farther than dog teams as well as pull a bigger payload. Travels over snow, patches of bare ground in tundra country, and across river sandbars that whipping wind has scoured clear of snow. With a toboggan in tow, Sno-traveler becomes versatile utility vehicle useful for transporting emergency service crew and tools to line break in otherwise inaccessible areas.

CIRCLE (45) ON THE REPLY CARD

Air conditioning filmstrip . . . provides utility and dealer salesmen with "conversational understanding" of Bryant air conditioning units. The 105-frame color-sound filmstrip, supplied with co-ordinated record, presents informative 20-minute training program for use at regional and local levels.

CIRCLE (46) ON THE REPLY CARD

Vest pocket guide to better welds . . . contains wealth of information valuable to engineers, training superintendents, and construction crews as well as welders. Gives information on essentials for proper welding procedures, welding metals, identification of metals, definitions of welding terms, types of joints, correct electrode selection, typical electrode deposition rates, and electrode pieces per pound.

CIRCLE (47) ON THE REPLY CARD

Unusual clothes dryer uses . . . drying dogs, kittens, newspapers, mink stoles . . . are illustrated in 32-page booklet entitled, "When Is a Dryer More Than a Dryer" prepared by Norge Division of Borg-Warner Corp.

CIRCLE (48) ON THE REPLY CARD

Sound and color strip film . . . prepared by Fisher Governor Co. . . . uses cartoons and diagrams to cover essential elements of gas regulators in informative entertaining manner. Film fits standard 35 mm strip film projector with 33⅓ rpm record player. Running time is approximately 30 minutes.

CIRCLE (49) ON THE REPLY CARD

Brochure-mailer . . . for customer promotional programs and mailings . . . describes Payne Company products, and typical heating installations. Copy suggests possibility of addition of matching cooling coils. Produced in 3 colors, the 6-page brochure doubles as a mailer when folded.

CIRCLE (50) ON THE REPLY CARD

Lancaster

non-crack SYNTHETIC DIAPHRAGMS

improve gas meter accuracies without changing index gear ratios . . . without fabric failure

Gas meters operate at regular speed with Lancaster diaphragms S-7-L (and S-70-L with new adjustable height side carrier and oval-slot center bracket) for 1-A, #240 and Beta gas meters!

You increase meter accuracy without increasing meter wear. There's no cloth lining to cause fabric failure . . . no need to change standard meter parts . . . no need to hurry up meter wear.

Actual service and laboratory tests have proved the high flexibility low differential and superior performance. Order Lancaster Synthetic Diaphragms.

Lancaster

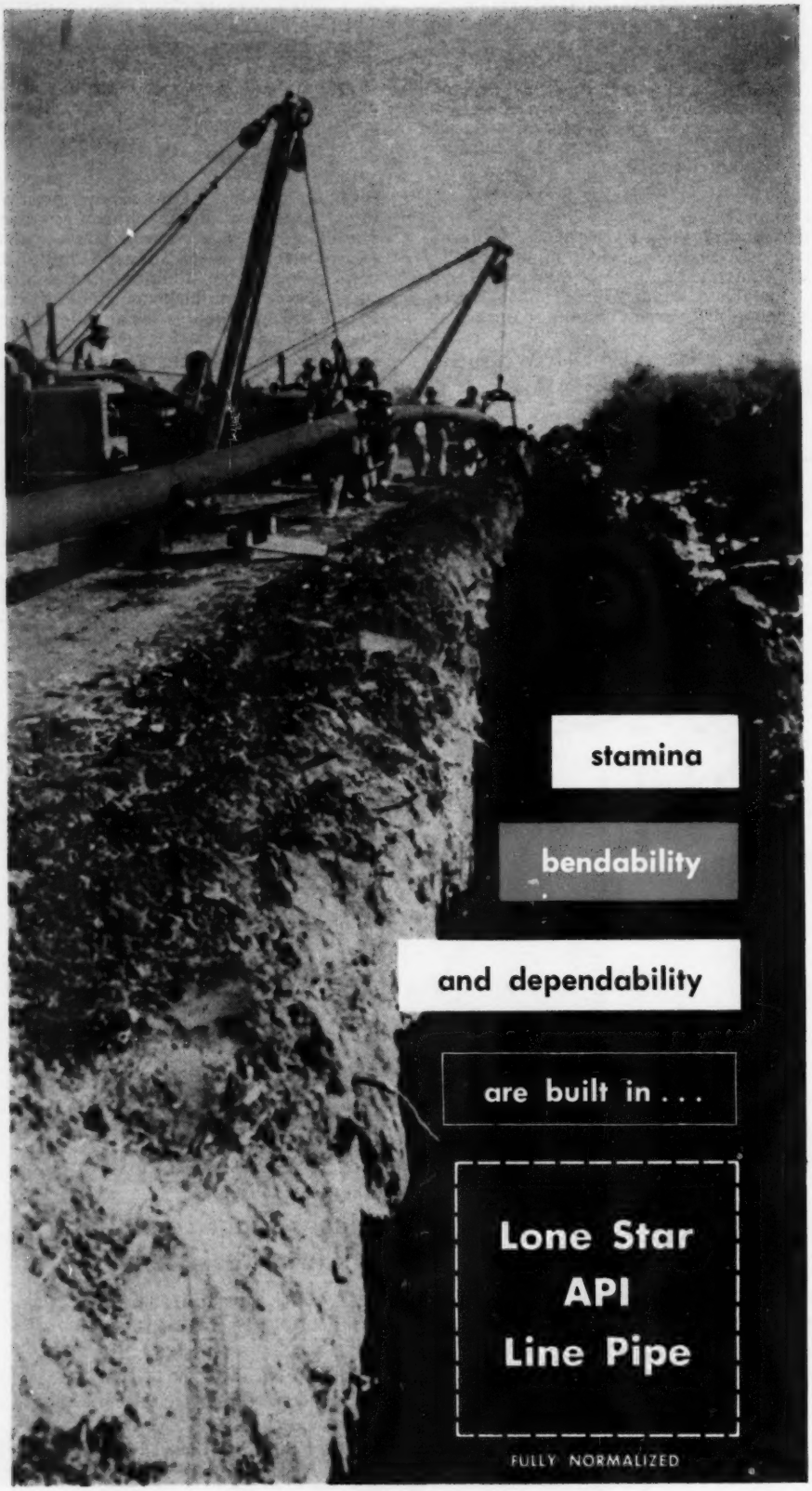
METER PARTS CO.

POST OFFICE BOX 378, LANCASTER, OHIO

Catalog No.	Sprague
S-70-L	1-A
S-70-L-240	240
S-7-L	1-A
S-7-L-240	240

Other Lancaster Synthetic Diaphragms	
C-1-L	#1 Ironclad
O-L	#0 Emco
1-L	#1 Emco

See catalog for complete line of leather diaphragms



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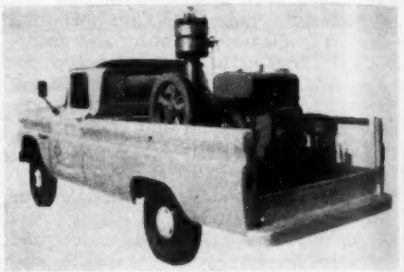
Houston, Texas | Midland, Texas | Tulsa, Oklahoma

PRODUCT PARADE

Computers "Talk" on the telephone. Two widely separated computers can now exchange information directly via telephone circuits while each continues to print out the results of calculations. IBM's new 1909 data transmission unit enables computers to hold direct, two-way telephone or telegraph "conversations" for the first time. Equipped with a 1009, a solid-state IBM 1401 computer can send business or scientific information any distance across the country directly from its magnetic core memory to the core storage of another 1009-equipped 1401. Data flows at speeds up to 150 numbers or letters per second over dial or leased telephone lines or high-speed telegraph lines.

CIRCLE (51) ON THE REPLY CARD

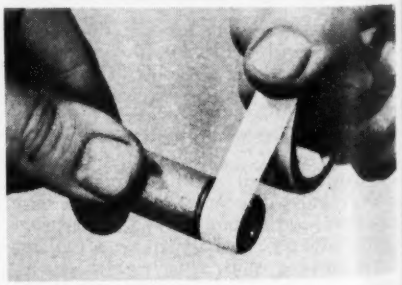


Mobile high pressure test unit . . . Consolidated American's new mobile unit for high pressure testing is completely self-contained and will measure pressure of any type of gas. Unit is fitted into a highly mobile four-wheel drive truck capable of moving over rough terrain. Capacity is 30 scf per minute. Unit is fast in measurement determination—compressor will pressurize 300 running ft of 2-in. pipe up to 15,000 psig in approximately 90 minutes.

CIRCLE (52) ON THE REPLY CARD

Recorder-controller . . . New differential pressure recorder-controller from Barton Instrument Corp. measures, records and controls flow of fluids. Intended for general recording and control application, new instrument combines best features of Barton's recorder case, rupture proof meter body, and widely accepted control components of U. S. Gauge pressure pilot. Illustrated factual bulletin available.

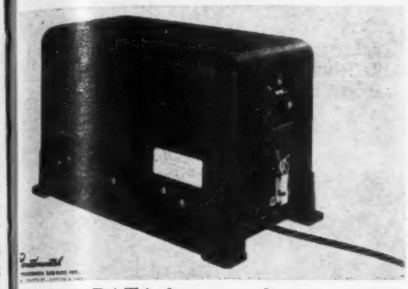
CIRCLE (53) ON THE REPLY CARD



NEW PLASTIC TAPE called Tape-Seal, made from DuPont's Teflon is now available for sealing threaded pipe joints from Friesland Plastics Company. Advantages include fast application; eliminates dripping or splatter; unaffected by temperatures from —250 F to +500 F; completely inert, will not leach out or contaminate, is unaffected by acids, alkalies or solvents; and does not harden after application, permitting easy disassembly. Available in widths of ½, ¾, or 1-in. in self-dispenser rolls of 250, 500, and 1000 in.

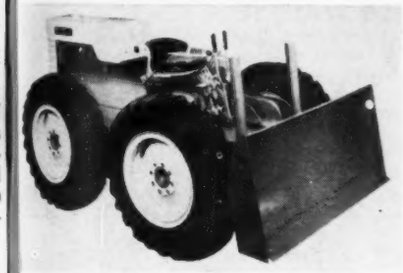
CIRCLE (54) ON THE REPLY CARD

PRODUCT PARADE



Talking DATA box . . . Spoken reports of flow meter readings are now possible with compact electro-mechanical "talking box" developed by Marathon Pipe Line Co., and currently manufactured and distributed by Continental Technical Service, Inc. The Digital-to-Audio Translator-Accumulator (D-A-T-A) unit can be used in almost any industrial or commercial application where flow meter readings are required. To obtain spoken report from distant point, a dispatcher merely dials a number and then listens to audible flow meter reading coming in over telephone or microwave system. Weighing only 26-lb. unit operates from regular 115-volt electrical connection, has built-in stand-by batteries in case of power failure.

CIRCLE (55) ON THE REPLY CARD



All wheel drive bulldozer from Detroit Tractor Ltd. is a utility size unit that features a 49-hp engine — either diesel or gasoline — and planetary steering, controlled traction, and maximum maneuverability. Designed to give operator full visibility of his work, unit has a low center of gravity but a full 20 inches of clearance. Positive up and down hydraulics, rugged bulldozer blade, and inside push arms allow precision work.

CIRCLE (56) ON THE REPLY CARD

GAS PROMOTION ENGINEER WANTED

Gas Promotion Engineer — Engineering degree with at least two years experience in the industrial, commercial and central house heating, air-conditioning and miscellaneous appliances, covering gas sales, engineering, supervisory installation and service. Must be thoroughly experienced in preparing heating and air-conditioning surveys and selling gas equipment for the promotion of gas sales, on the Northwest Gulf coast of Florida. Starting salary, $496 ranging to $598 per month. Maximum age, 35. Send full resume to Box 212, American Gas Journal, P. O. Box 1589, Dallas, Texas.

REPRESENTATIVE WANTED

in your territory. From your desk you can earn a substantial addition to your income. Only written contracts with your clients! Write for particulars and further details to VKK-Office, Vienna 66, P. O. B. 128, Austria.

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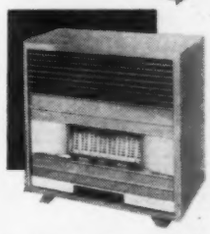
EVERYONE'S A CUSTOMER FOR A **DEARBORN**

"What a lure!"

No one can resist the beauty . . . the charm . . . the downright heating comfort of a new Dearborn. Your "regular" customers, too, are certain to buy when you show them a few of Dearborn's great heating features. The Dearborn Control Center, for example . . . assures complete heat control and greater operating economy because it activates the Thermo-thrust Blower exactly as the user desires. Another reason Dearborn is the top heating value on the market today.

CONTROL CENTER



Push-button controls activate the most powerful blower in the industry. May be used for summer as well. With Dearborn, it's a "set it and forget it" operation.

The Dearborn Regency is the world's finest gas area heater. Lower, longer and loaded with *sell-on-sight* appeal!

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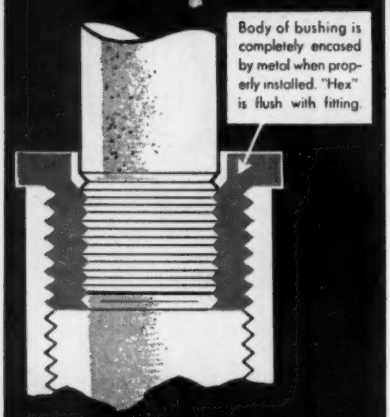
Get details of Dearborn's clean-cut selling policy from any of these regional sales offices: Atlanta, Chicago, Dallas, Los Angeles, San Francisco.

1960 Dearborn Stove Co., Dallas

MAYCO

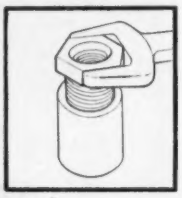
NYLON DIELECTRIC BUSHINGS



Stop Electrolysis!

■ Sandwiched between two dissimilar metals, Mayco nylon dielectric bushings prevent metal to metal contact – stop *electrolytic* action!

Able to withstand pressures in excess of 1000 lbs. and temperatures over 300°F, Mayco dielectric bushings gain added strength from clamping action of surrounding metal.



Most sizes also available with extra-heavy "Hex" to facilitate use of ordinary wrench.

Couplings and unions also available factory equipped with Mayco bushings.

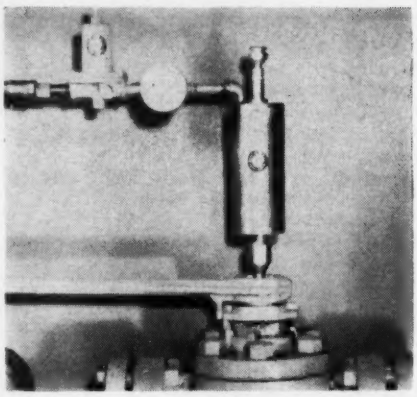
Order Mayco Dielectric Bushings from your jobber or write to:

MAY PRODUCTS, INC.

BOX 427, GALESBURG, ILLINOIS

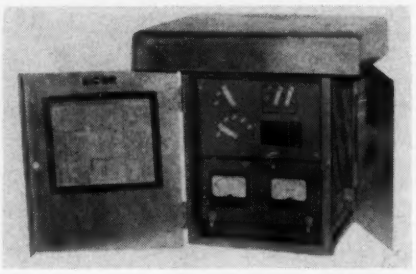
Manufacturers of: MAYCO dielectric fittings and MAYCO water softeners and filters

PRODUCT PARADE



Automatic valve lubricator . . . Designed to provide lubricated plug valves with a continuous and regulated supply of lubricant, Rockwell's new automatic pressurized lubricator is particularly applicable for remote valve installations where controlled and automatic lubrication is necessary. Lubricant acts as a seal when valve is closed, and provides hydraulic action to make long-disused vlaves easy to turn. Built-in indicator, remote control and light weight are advantages of new lubricator.

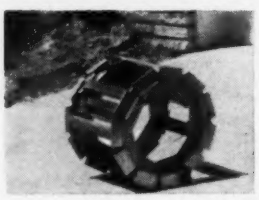
CIRCLE (57) ON THE REPLY CARD



One-unit cathodic protection rectifiers are now available in four standardized case sizes from Eicor, Div. of The Scranton Corp. Each transformer is custom-designed and manufactured with sufficient safety factor for intermittent overloads. Rectifiers are produced in sizes to fit any one of four compact 11-gage steel case sizes designed to meet most specific load requirements. Cases may be pole or platform mounted. Wide swinging doors, which may be padlocked, open to equipment panel from front or side. Condulet fittings allow easy input power connections; panel switch and overload protector are included in primary circuits; input voltage is 115 volt, 60 cycle, single phase.

CIRCLE (58) ON THE REPLY CARD

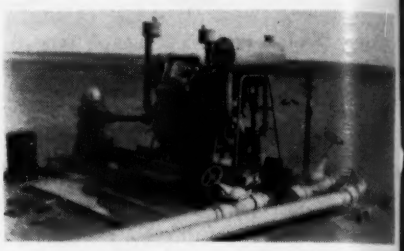
Roll-up ladder . . . New patented aluminum ladder manufactured in 12 and 16-ft lengths by Aladdin's Products, rolls up into compact bundle so it can be carried like suitcase or transported in trunk of compact car. Unrolled and locked in position, ladder becomes rigid and handles like any conventional straight ladder; easily supports load of 1000 lb. Eliminates need for truck or ladder rack; easily stored on shelf or in any small space. The 16-ft size rolls up into 20-in. diameter bundle weighing approximately 24 lb.



CIRCLE (59) ON THE REPLY CARD

Split-body control valves . . . both the new "S" and "Y" style valves, each with its own angle variation . . . are included in new 20-page catalog from Hammel-Dahl Div. of General Controls. Four double-page spreads detail specifications, data and dimensions of various valve bodies with accessories such as positioning piston actuators, on-off piston actuators, electro-hydraulic actuators, and manual actuators.

CIRCLE (60) ON THE REPLY CARD



Cooling system for non-radiator cooled engines such as natural gas-fueled irrigation engines has been developed by International Harvester. Recommended for all heat-exchanger-cooled IH engines, the new cooling system control maintains high-volume, high-velocity coolant flow for more uniform engine temperatures and to extend service life of valves, piston, piston rings, and sleeves. Hot spots and steam pockets are eliminated, and foaming and air entrainment problems, inherent with continuous duty applications, are controlled. Presently, system is available for three IH V-8 engines (UV-401, UV-461, UV-549) and three six-cylinder engines (UR-372, UR-450, UR-501).

CIRCLE (61) ON THE REPLY CARD

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